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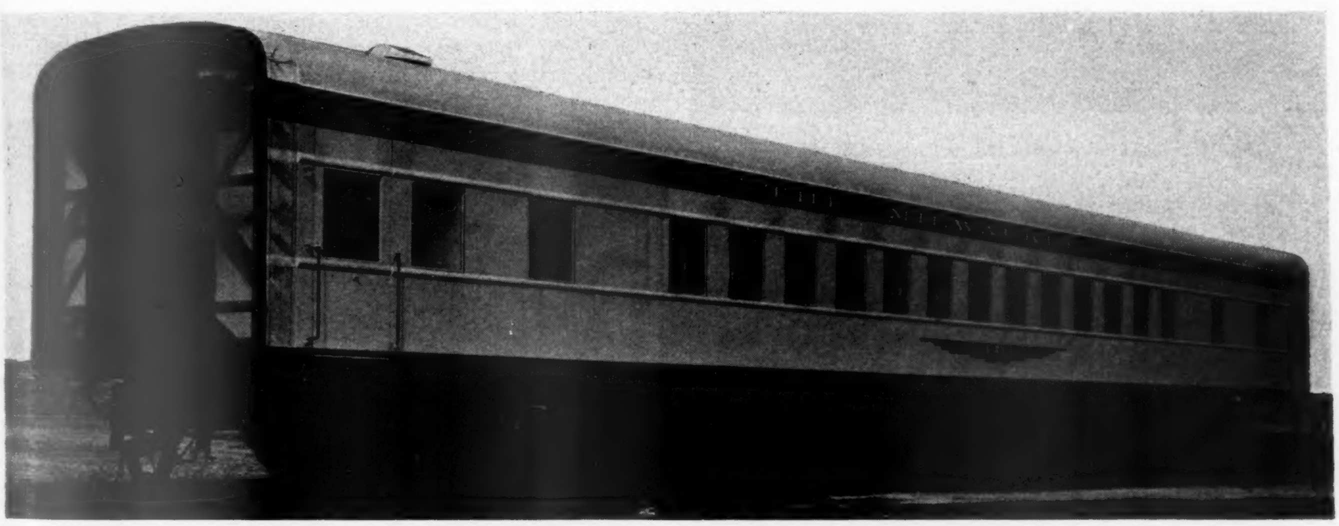
RAILWAY MECHANICAL ENGINEER

Weight Saved in

New Hiawatha Cars

The use of Cor-Ten steel in superstructures, additional aluminum alloys for interior trim and lighter couplers, draft gears and brake rigging has effected a further weight reduction of 10 per cent as compared with the welded cars first installed in this train

COMPLETE new car equipment has recently been placed in service by the Chicago, Milwaukee, St. Paul & Pacific on the Hiawatha, its light-weight, high-speed train between Chicago and the Twin Cities, Minn. Not only are the new nine-car train units lighter in individual car weight, but they have also been changed in interior arrangement to provide enlarged dining facilities and more salable passenger seats. The structural design has been based on the use of Cor-Ten steel. The cars are better insulated, the air-conditioning improved and the exterior appearance changed by tying the windows together in a longitudinal panel effect which is continuous throughout the length of the train. The equipment replaced will be used in a second section



One of 17 luxurious modern coaches recently built for use in the newly equipped Hiawatha

of the Hiawatha operating between Chicago, Milwaukee, New Lisbon and Minocqua, Wis., via the Valley division.

The new cars were designed and built at the road's Milwaukee shops and are similar in shape and general dimensions to the cars first used when the Hiawatha service was inaugurated in 1935. These cars were, in turn, similar to the all-welded, light-weight steel coach built by the C. M. St. P. & P. in 1934,* except for the inclusion of cast-steel underframe ends, the installation of double windows, changes in interior finish and decoration and the installation of air conditioning. The original cars of the Hiawatha weighed from 31 to 33 per cent less than riveted steel cars of the same capacity. By the use of Cor-Ten steel for the car superstructures, underframes and load-carrying members; by the more extensive use of aluminum alloys for interior trim, air-conditioning ducts, conduit, brake cylinders, slack adjusters, etc., and by the lightening of such parts as car floors, couplers, draft gears and brake rigging a further saving of about 10 per cent has been effected in the new cars, so that they are from 41 to 43 per cent lighter than conventional steel passenger cars.

What this weight reduction, in conjunction with roller-bearing trucks, means in the way of reduced tractive force requirements can be readily appreciated when it is observed that the same locomotive which made the high-speed schedule between Chicago and the Twin Cities with seven cars in the 1934 Hiawatha can make the same schedule with nine cars in the 1936 Hiawatha. Reference to the table shows an increase

* For a description of the original car see the *Railway Mechanical Engineer*, October, 1934, page 361, and December, 1934, page 444.

in train weight from 1,355,300 lb. to 1,408,800 lb., or only about 27 tons, in spite of the addition of two extra cars. The table also shows an increase in the number of individual seats from 376 to 464 and a decrease in car weight per individual seat from 2,146 lb. to 1,854 lb., or 13.6 per cent.

Principal Changes in the New Train

Aside from the use of Cor-Ten steel and aluminum alloys, as already described, to reduce weight, the principal changes in design of cars for the new train are: (1) the substitution of built-up welded sheet construction with stiffeners, instead of the pan construction first employed; (2) the more extensive use of spot welding in connection with arc welding for fabrication

The "Tip Top Tap" room in the forward end of the train

purposes; (3) the provision of a 10-in. H-beam for the center sill instead of a 12-in. A.A.R. section, thus giving 2 in. more rail clearance; (4) the mounting of all air-conditioning equipment, batteries, water tanks, etc., in a narrow streamlined rectangular steel shell under the center sill, thus reducing wind resistance underneath the car and lowering the center of gravity of the car† about 7 in. to a point below the floor line, or approximately 4 ft. 2 in. above the rails; (5) the provision of rubber-covered closures between the cars and retractable vestibule steps to still further accentuate the streamline effect and reduce wind resistance; (6) the entire elimination of vestibules and steps in the diner and the express tap-room car, and the provision of only one vestibule in each of the other cars.

Improvements in the air conditioning system include a certain reduction in weight in the Safety-Carrier six-ton steam-jet unit which is installed under each car, and the provision of a more compact design. Somewhat more powerful fans are used in the air distribution system and a revised double air duct arrangement provides for a more effective distribution of the conditioned air throughout the length of the various cars. The same blower is used to circulate the cooled air as is used for the heated air in the heating season. Heated air is introduced in the car body through grilles located near the floor and the cooled air through grilles located in the luggage rack near the ceiling. There are no conventional heating pipes in the body of the car. Standby or yard heat is provided by a concealed radiator in each end of the car.

† The center of gravity referred to is that of the combined car body and trucks.

The lighting equipment is also revised to a certain extent to provide increased candle power where needed, the intensity of illumination being controlled by means of lenses. In the coaches, a high intensity is obtained at the reading level with two lenses for each seat. The fixtures are located at the sides underneath the luggage

Table I—Scale Weights of Hiawatha Trains of the C. M. St. P. & P.

	1934 Hiawatha No. of Cars	1934 Hiawatha Weight in lb.	1936 Hiawatha No. of Cars	1936 Hiawatha Weight in lb.
Express tap-room car	1	131,500	1	96,200
Coaches	4	448,800	4	379,600
Dining car	..	......	1	102,300
Parlor car	1	113,700	1	95,100
Drawing room parlor car	..	......	1	95,200
Beaver-tail parlor car	1	112,900	1	92,000
Total car weight	7	806,900	9	860,400
Locomotive weight		548,400		548,400
Total train weight		1,355,300		1,408,800
Total seating capacity		376		464
Number of salable seats		238		291
Car weight per individual seat		2,146		1,854
Car weight per salable seat		3,390		2,957
Train weight per individual seat		3,604		3,036
Train weight per salable seat		5,694		4,841

rack. In the dining and tap room cars the plane of the lenses is horizontal, with the light controlled so as to produce the highest intensity of illumination on the table top, keeping all direct glare out of the eyes of the passengers.

Important changes are also made in the consist of the train, which includes the express-tap room car, the diner, four new coaches, a parlor car, a drawing-room parlor car and a beaver-tail parlor car. The

One of the new coaches

dining car is located in the middle of the train instead of at the head end in combination with the tap room. The coaches have greater seating capacity and more storage space for luggage. Three parlor cars are provided instead of two and this permits reducing the size of men's and women's lounge rooms in some of the other cars.

Description of the Equipment

The 18 cars of the new Hiawatha are part of a complete order of 37 cars, just completed at Milwaukee shops, which will be used in a pool with the older cars to meet the requirements for four separate train units.

One of the large dining cars

This new equipment includes five baggage cars, five mail-express cars, two diners, two express-tap room cars, two parlor cars, two drawing-room cars, two beaver-tail parlor cars and 17 coaches. All of the cars are semi-tubular in shape with turtle-back roofs and sides curved inward slightly at the bottom. They present a flush outside surface on the sides and roof and, by provision of the full-width, rubber-covered diaphragms between cars, the train gives the appearance of a unit train without any sacrifice of interchangeability to meet varying traffic requirements. Like the preceeding lot, each new car is slightly less than 82 ft. long between coupler pulling forces and the total length of nine cars is therefore about 737 ft. The cross section dimensions are essentially the same as those given in the article describing the first welded steel car.

Particular attention has been paid to insulation and sound deadening, all interior steel surfaces being sprayed with a sound-deadening compound containing cork, with the insulation of the sides and roof applied while the sound-deadening material was still wet. It is expected that this type of construction will assist in reducing noises in the cars. The sides and roof of the cars are insulated with Dry Zero, the sides having 3 in. of insulation and the roofs 2½ in. To facilitate the application of the insulation, the material is worked up in blanket form, a separate blanket being prepared beforehand of the proper size to fit the cavities between the posts or carlines. The floors are insulated with fibre glass and here, also, the insulation is furnished cut to size for each cavity in the floor.

The four-wheel trucks, equipped with Commonwealth cast-steel frames, Timken roller-bearing and Simplex clasp brakes, represent a further refinement in design, whereby the weight is reduced from 15,195 lb. per truck in the original train to 14,513 lb. per truck in the new Hiawatha. Brake cylinders and slack adjusters are made of aluminum alloys, and brake levers are reduced in cross-section and weight wherever feasible by the use of high-tensile alloy steel. The Safety truck-mounted generator is equipped with Dayton-Roderwald V-belt drive.

The exterior appearance of the new train is striking. Aluminum paint is used on the car roofs and the sides are in orange yellow. The top border on the sides is in maroon with an aluminum stripe separating it from the yellow of the car sides. Above and below the windows are raised moldings finished with aluminum, and near the bottom of the sides there is a silver stripe and maroon border. Housing under the cars is brown, as are the trucks. A wing design, similar to the one on the head of the locomotive, is painted on the sides of each car and in the middle of each wing the car number or name appears. On the rear of the beaver-tail car there is a wing with "Hiawatha" in the center.

Table II—Comparative Weight (In Pounds) of C. M. St. P. &P. All-Welded Passenger Coaches of 1934 and 1936

	1934	1936
Car body	72,200	56,102
Trucks*	32,800	29,026
Car weight	105,000	85,128
Air-cooling equipment	7,200	5,455*
Total car weight (including air-conditioning equipment)	112,200	91,983

* Includes heating and air-conditioning equipment.

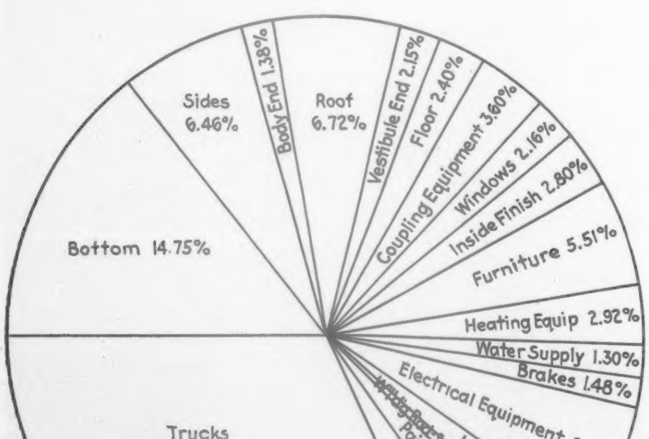
The interior arrangement of the various cars is indicated on the floor plans. In the express-tap-room car an enclosed compartment in the forward end, 30 ft. 6 in. long, is used for through express. The tap room has a bar extending across the entire width. Bar service is available at all times enroute. There are 10 tables each seating at least four people, the capacity, therefore, being referred to as 40. However, at the circular tables six people can be seated comfortably. There is a push button at each table to summon a waiter. There are no vestibules or windows, save for a port hole on either side near the bar.

The rubber-covered diaphragm closure between cars and retractable vestibule steps

The ceiling is curved and painted a bone white. Pan-

The rear of one of the new beaver-tail parlor-observation cars

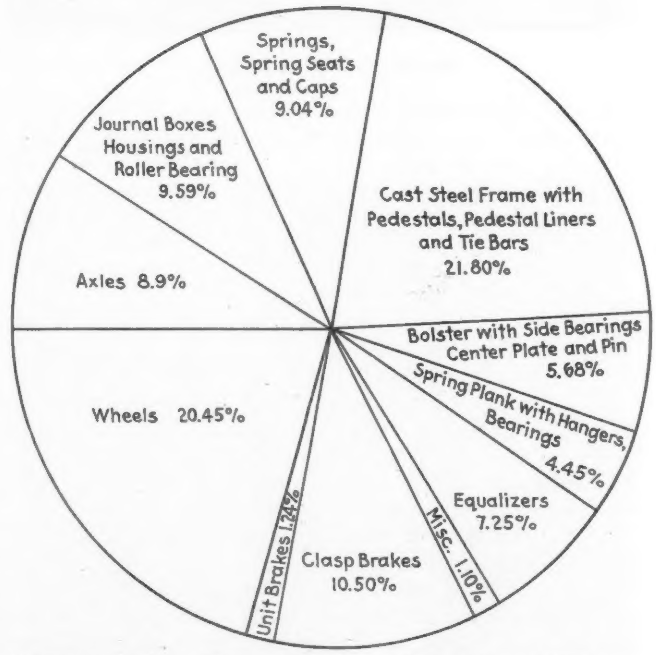
els at tables have modernistic mirrors, with a background painted peach. Panels are trimmed with stainless steel and wainscoting set off with two stainless-steel bands set in wood moulding. Moulding between the bands is painted orange. Walls surrounding the panels are painted with five shades of blue properly blended. The floors are covered with mottled grey rubber. Tables are rubber-covered and have table legs and pedestals of polished aluminum. Seats have polished aluminum frames, with seats and backs covered with red leather.



Total weight, lb.	91,983
Weight per sq. ft. floor area, lb.	128
Seating capacity	66
Weight per passenger, lb.	1,393

Distribution of the weight of the 1936 coaches

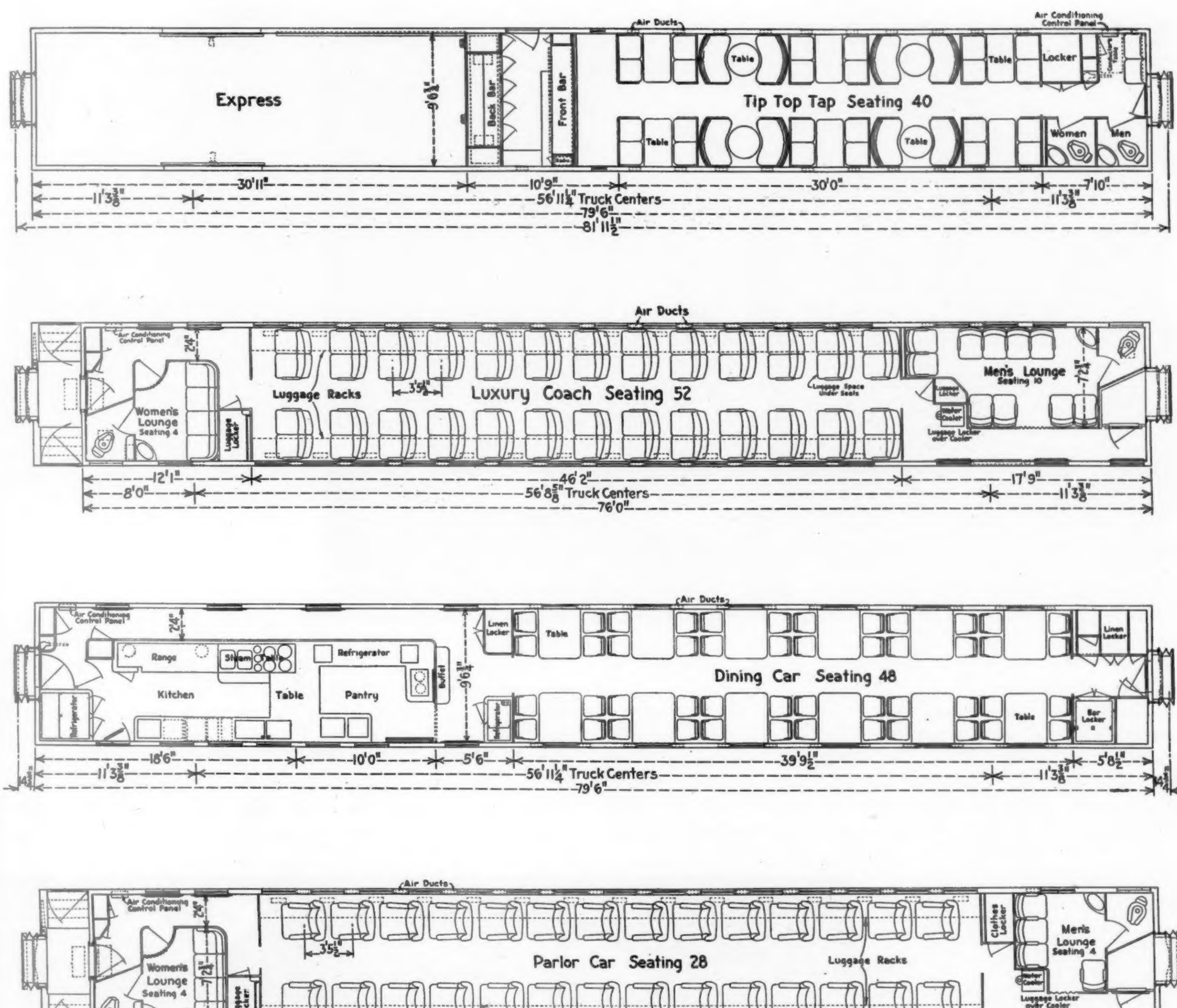
The tap room car also has a small compartment equipped with a work table for the train conductor.



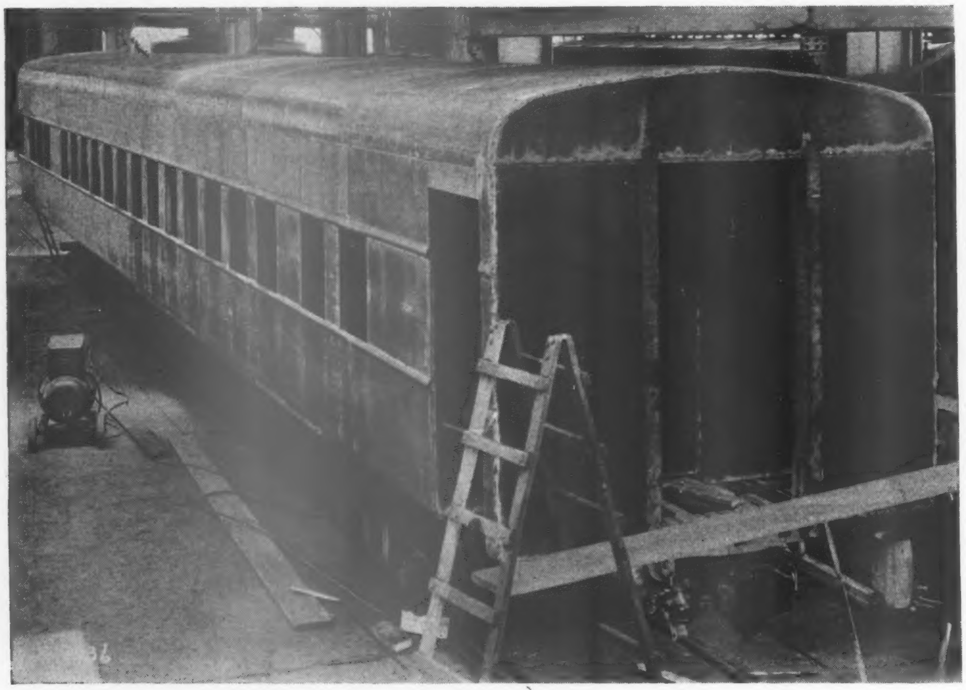
Weight with clasp brakes, unit brakes, Timken roller bearings and housings, lb.	14,513

Distribution of the weight of the 1936 four-wheel 5-in. by 9-in. cast-steel passenger truck

The coaches have vestibules at but one end; normally, the forward end. The main passenger compartment, 46 ft. 2 in. long, seats 52. The men's lounge, 14 ft. long, seats 10. The ladies' lounge, 6 ft. long, seats 4. The seats in the body of the car turn in pairs, but may be reclined separately. They are luxuriously upholstered and are spaced 3 ft. 5 in. between centers. Wide windows are placed slightly forward of the seats. Exceptionally wide overhead luggage racks extend the entire length of the car. Roomy space is available under the seats for the storage of luggage and at one end of the car there are compartments for the storage of hand



Floor plans of the types of cars used in the newly equipped Hiawatha trains



A car with the underframe sides, roof and ends assembled ready for finish welding

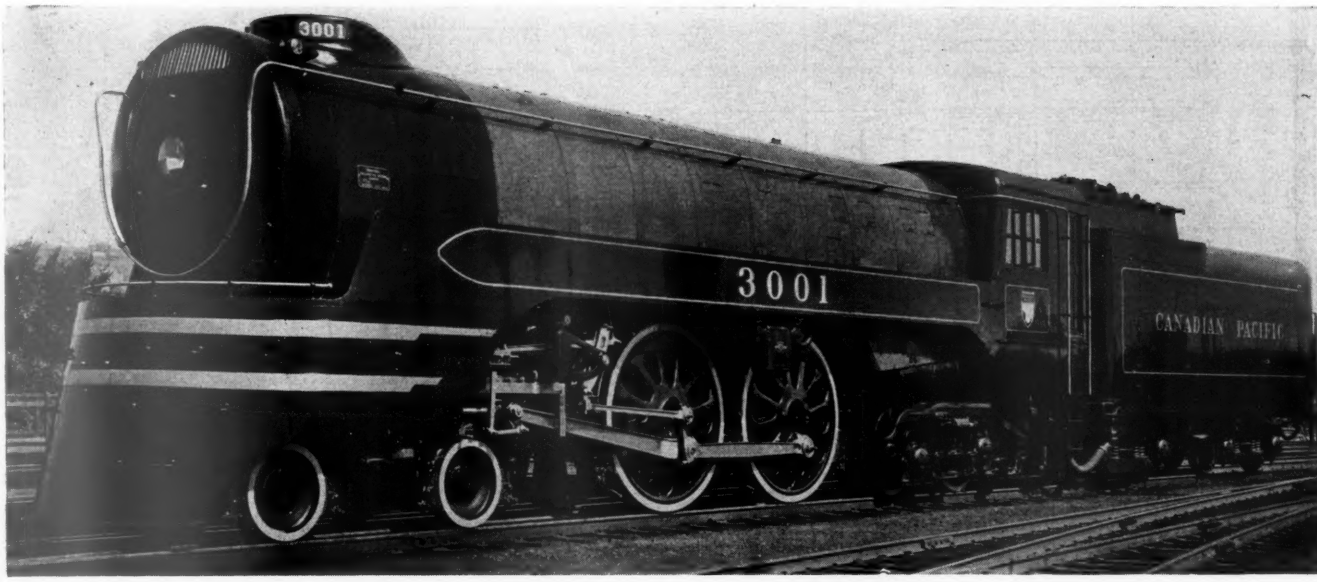
baggage and clothes. Electrically refrigerated water coolers are provided.

The dining car provides seats for 48, the largest capacity of any self-contained dining car unit in the country. The length of the dining compartment is 40 ft. The decorative scheme includes bone-white ceilings, silver-gray walls of imported Harewood veneer, dark blue carpeted floor. Tables are of chromium tubing with blue rubber tops; chairs of polished aluminum upholstered with coral velour. The diner is equipped with a pantry 10 ft. long and a kitchen 18 ft. 6 in. long. A specially-devised cooling system provides comfort for the kitchen crew in what would otherwise be extremely warm quarters. Fuel oil is burned in the range.

The parlor car has 28 swivel chairs in the main passenger compartment which is 51 ft. 3½ in. long. Four seats are provided in the men's lounge and four in the ladies' lounge, each of these lounges being slightly over 6 ft. long. Adjacent to each seat in the body of the car is a small shelf or table-like arrangement that folds and fits into the wall when not required by passengers for such use as writing or holding reading material. All parlor cars have bone-white ceilings, walls above the window sills and ends of Avodire veneer with African mahogany wainscoting, aluminum window frames and molding. The floors are covered with carpet of two shades of blue in the body of the

(*Continued on page 477*)

Completed underframe with all underneath parts housed in a streamline metal box under the center sill



Canadian Pacific locomotive for light high-speed passenger service

High-Speed

Steam Locomotive for C.P.R.

Semi-streamline 4-4-4 type has 80-in. drivers and develops 26,500 lb. tractive force. It will haul trains of new light-weight coaches, with which it will harmonize in appearance.

SINCE late in July the Canadian Pacific has received from the Montreal Locomotive Works, Ltd., five semi-streamline locomotives for high-speed passenger service. The locomotives are of the 4-4-4 type and will be used to haul trains made up of new steel passenger coaches, the weight of which has been kept low by careful designing. The total weight of the locomotive is 263,000 lb., of which 120,000 lb. is on the two pairs of drivers. The driving wheels are 80 in. in diameter, the cylinders 17¼ in. by 28 in., and, with a boiler pressure of 300 lb. per sq. in., the locomotive develops a tractive force of 26,500 lb.

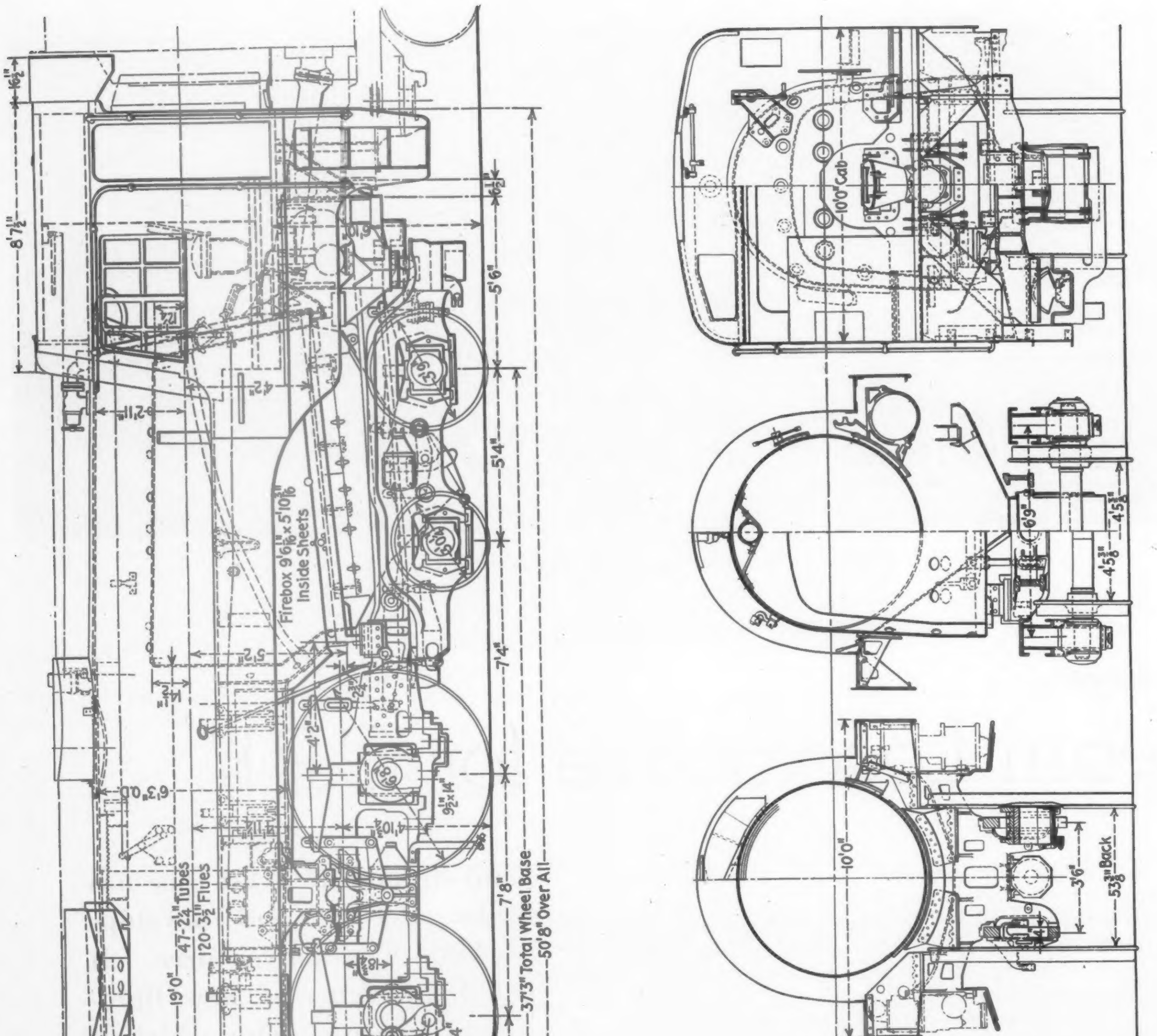
The Boiler

The boiler is of the conical type with three shell course of nickel steel. The first course is 68 in. in inside diameter, the second course is conical, and the third 75 in. in outside diameter. The first course is of $^{23}/_{32}$-in. material; the second, of ¾-in. material, and the third, of $^{25}/_{32}$-in. material. The firebox sheets and staybolts are also of nickel steel. There is no combustion chamber, and the length over tube sheets is 19 ft.

The boiler is built without a steam dome. An inside dry pipe, 8 in. in outside diameter, closed at the rear end and extending back about 2 ft. into the third shell course, gathers steam through a series of circumferential slots in the top surface. These slots, the length of which in horizontal projection is 4 in., have a combined area which is approximately twice the cross-sectional area of the dry pipe. It will be seen from the detailed drawing that the slotted portion of the pipe is enclosed between transverse end pieces, which extend up to and conform with the curvature of the shell courses, and flanged sides, joined to the ends by spot welding, which lie parallel to and rest upon the dry pipe. The effect of the passage thus formed on either side of the dry pipe is to spread the water-surface area over which the steam rises sufficiently to prevent the lifting of the water and to effect a much steadier level of the water in the water glass. This form of dry pipe has been developed as the result of experience during recent years on some of the largest locomotives in use on the Canadian Pacific.

In place of the dome a manhole 17½ in. in diameter is provided through the top of the third course in front of the firebox. A flanged ring provides a seat for a flat cover on which the safety valves are mounted. Threaded safety valve connections have been replaced on this road by bolting flanges with flat ground joints in order to overcome the frequent distortion of the valve seats from too severe use of the wrench. The whistle, which also has a flange base, is studded to the boiler shell immediately back of the manhole ring. The steam connection is by pipe to the side of the whistle base from the superheated-steam turret.

In the fabrication of the boiler shell nickel-steel rivets have been used for the first time in order to secure a higher shearing value and in order to provide a better balanced seam in the high-tensile plate. Seal welding is employed on the calking edges around the mud-ring



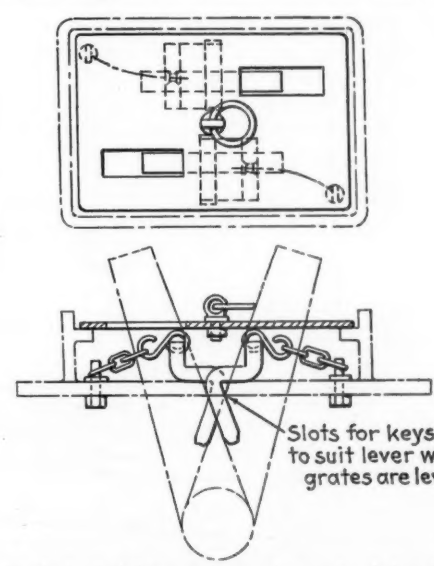
Elevation and cross-sections of the Canadian Pacific locomotive

corners and 10 in. up the calking edges of the vertical side- and wrapper-sheet seams. Pads for the blow-off cocks are also welded to the wrapper sheets. On the boiler shell welding is applied at the ends of the outside butt straps of the longitudinal seams. At the front end of the first course the shell seam is butt welded back for a distance of 16 in.

There are four arch tubes in the firebox. At the throat ends these are rolled and beaded into ported forged-steel sleeves which extend through the water space and are threaded and welded to the inside and outside sheets. The outer end is closed with square-threaded plugs. These have been used with success for some years on the Canadian Pacific. The grates are of the rosebud or pin-hole type and are of chromite heat-resisting steel. The side bars are closely fitted against the side sheets and the usual deflector plates are applied at the mud ring under the side carriers to deflect cold air currents inward and to prevent them from sweeping directly up along the side sheets. This has prevented trouble from firebox side sheets cracking. The ash-pan hopper and door are of cast steel, while the body of the pan is of plate construction. Drop side doors at the top of the ash pan are provided to facilitate cleaning and inspection.

General Dimensions, Weights and Proportions of the Canadian Pacific 4-4-4 Type Locomotive

Railroad	Canadian Pacific
Builder	Montreal Loco. Works
Type of locomotive	4-4-4
Road class	F-2-a
Road numbers	3000—3004
Date built	1936
Service	Passenger
Dimensions:	
Height to top of stack, ft. and in.	14—11½
Height to center of boiler, ft. and in.	9—10
Width overall, in.	128⅛
Cylinder centers, in.	77
Weights in working order, lb:	
On drivers	120,000
On front truck	68,000
On trailing truck	75,000
Total engine	263,000
Tender	198,500
Wheel bases, ft. and in.:	
Driving	7—8
Front truck	7—2
Trailing truck	5—4
Engine, total	37—3
Engine and tender, total	70—8¾
Wheels, diameter outside tires, in.:	
Driving	80
Front truck	33
Trailing truck	36¼ and 45
Engine:	
Cylinders, number, diameter and stroke, in.	2—17¼ × 28
Valve gear, type	Walschaert
Valves, piston type, size, in.	9
Maximum travel, in.	6½
Steam lap, in.	1⅛
Exhaust clearance, in.	¼
Lead, in.	¼
Cut-off in full gear, per cent	84
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	300
Diameter, first ring, outside, in.	$69\frac{7}{16}$
Diameter, largest, outside, in.	75
Firebox, length, in.	$114\frac{1}{16}$
Firebox, width, in.	$70\frac{8}{16}$
Height mud ring to crown sheet, back, in.	58¾
Height mud ring to crown sheet, front, in.	73
Arch tubes, number and diameter, in.	4—3½
Tubes, number and diameter, in.	47—2¼
Flues, number and diameter, in.	120—3½
Length over tube sheets, ft. and in.	19—0
Net gas area through tubes and flues, sq. ft.	6.03
Fuel	Bituminous
Stoker	Standard Type BK-1
Grate type	Rosebud
Grate area, sq. ft.	55.6
Heating surfaces, sq. ft.:	
Firebox	198
Arch tubes	34
Firebox, total	232
Tubes and flues	2,601
Evaporative, total	2,833
Superheating (Type E)	1,100
Combined evap. and superheat	3.933
Feedwater heater, type	Elesco
Tender:	
Style or type	Rectangular
Water capacity, Imperial gal.	7.000
Fuel capacity, tons	12
Trucks	Four-wheel
Journals, dia., in.	6.2992
General data, estimated:	
Rated tractive force, engine, 85 per cent, lb.	26,500
Speed at 1,000 ft. per min. piston speed, m.p.h.	51
Piston speed at 10 m.p.h., ft. per min.	196.1
R.p.m. at 10 m.p.h.	42
Equiv. evap. per sq. ft. evap. h.s. per hr.	13.3
Weight proportions:	
Weight on drivers ÷ weight, engine, per cent	45.6
Weight on drivers ÷ tractive force	4.52
Weight of engine ÷ evaporation	6.97
Weight of engines ÷ comb. heat. surface	66.87
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	5.89
Tube-flue heat. surface, per cent comb. heat. surface	66.13
Superheat. surface, per cent comb. heat. surface	27.96
Firebox heat. surface ÷ grate area	4.17
Tube-flue heat. surface ÷ grate area	46.78
Superheat. surface ÷ grate area	19.78
Comb. heat. surface ÷ grate area	70.73
Gas area, tube and flue ÷ grate area	0.1082
Tractive force ÷ grate area	476.61
Tractive force ÷ comb. heat. surface	6.73
Tractive force × diam. drivers ÷ comb. heat. surface	539.02



Method of locking and covering grate-shaker levers in the cab floor

The boilers are fitted with the Type E superheater, in the header of which is included the American multiple throttle. The Elesco feedwater heater is mounted in a deep recess in the top of the front end of the smokebox. The steam connections between the cylinders and the header are installed with gland-packed slip joints where the pipes are attached to the cylinders. This arrangement has overcome the considerable difficulty formerly experienced with failures of these pipes from expansion and contraction stresses. The front end is fitted with a barrel type of netting, oval in horizontal cross-section. The netting fits into grooved castings at the top and bottom and may be readily removed. This is an arrangement with which the railroad has been experimenting with considerable success during the past few years.

The stack and stack cowling form the only projection above the surface of the cowling over the boiler. The stack is of the inside extension type and at the top is enclosed by a streamline casing, the top of which is flush with the top of the stack and in which is the smoke-lifter air passage which opens upward behind the stack and has its intake through a grille in the casing over the smokebox front.

The frames are of nickel cast steel, joined at the front

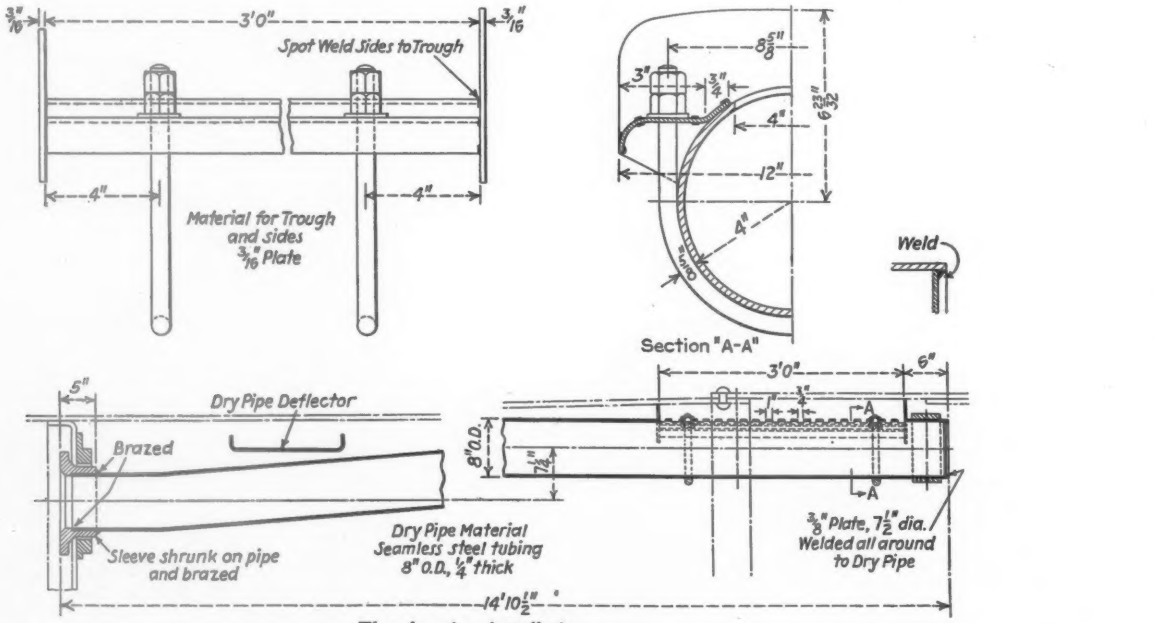
by a steel deck casting, at the rear by a General Steel Castings cradle, and by intermediate castings between the two pairs of drivers, in front of the front pair of drivers and by the guide yoke. The most important of these castings is that between the two pairs of drivers. This not only serves as a vertical crosstie and horizontal brace for the frames, but also provides a support for one of the brake cylinders and is extended upward at the ends to provide brackets for the 8½-in. cross-compound air compressor on the right side of the locomotive and the Elesco feedwater pump on the left side. These two pieces of equipment are thus placed in balance with each other and the boiler shell is relieved of the stresses caused by their direct attachment to the boiler. Both are readily accessible, removable panels being provided in the running-board skirts for this purpose.

The four-wheel engine and trailing trucks are of General Steel Castings design. Both are fitted with SKF roller bearings.

thoroughly lagged with asbestos mortar and Johns-Manville sponge blocks. The pistons are fitted with Hunt-Spiller Duplex special locked type lip rings and the valve rings are the Hunt-Spiller Duplex sectional type. The guides and crossheads are of the single-bar Dean type. The locomotives are equipped with Walschaert valve motion and Barco Type B-4 power reverse gear. The valves are 9 in. in diameter and have a maximum travel of 6½ in. They have a steam lap of 1⅛ in., an exhaust clearance of ¼ in., and are set with ¼ in. lead.

Cowling and Boiler Mountings

The streamlining consists of a cowl which completely encloses the boiler and smokebox back to the cab, with a heavily reinforced sloping shroud around the front end below the smokebox which serves as a pilot and extends around the sides to enclose the steam chests and cylinders. This is relieved by two horizontal stripes of polished metal, which conform in appearance to the polished steel of the rods and motion work. Skirts extending about 2 ft. below the running boards along the sides of the boiler conceal the piping, the reverse gear, an air reservoir on each side and (partially) the air compressor and the feed-water pump. At the rear end these blend into the sides of the cab. The front corners of the cab are rounded.



The dry-pipe installation

The driving-wheel centers are Boxpok type mounted on axles of carbon steel fitted with journal boxes of the crown-brass type. The rods are tandem type, and the distance between cylinder centers has been kept down to 77 in. Crank pins are of low carbon nickel steel with 2.5 per cent nickel and .20 to .27 per cent carbon, double heat-treated. The rods are quenched nickel-steel forgings with .32 per cent carbon and 2.5 per cent nickel.

Both pairs of main wheels are cross-counterbalanced. The amount of cross-balancing necessary, however, was reduced by the use of the tandem rods and by the fact that the main connection is on the leading driving wheels, thus greatly reducing the cylinder spread and the loads on the crank pins, wheel centers, axles and main frames because of the reduced bending movements. Contrary to the general practice in cross-counterbalancing, the Canadian Pacific does not use an offset balance weight, preferring to employ a supplementary weight set at 90 deg. to the main balance weight. In this way the balance can be readily adjusted in the event of any change in the rods or crank pins. With the customary offset in the angle of the balance weight, adjustments require a change in this angle, which is not readily effected.

The cylinders are nickel iron castings. Each cylinder and half saddle is cast as a unit. The cylinders are

The general arrangement of parts usually mounted on the boiler, with the exception of the bell, has not been greatly disturbed by the application of the lagging. The feedwater heater, the smoke stack, sand boxes, top boiler check, safety valves, whistle and steam turret are in the customary locations. The bell, however, is located on the left back steam chest cover just under the running board, and one of the three air reservoirs has been placed on the deck casting under the front end of the smokebox. The headlight generator set has been placed on the back deck casting under the floor of the cab, and the exhaust piped up through the cab to the roof. Two of the locomotives are equipped with Stone-Franklin and three with Pyle-National sets. All are 32-volt, a.c. generators.

The boiler is lagged in the usual manner. The outer casing is built with a frame of angle construction covered with a planished steel jacket. This encloses everything mounted on the upper part of the boiler, with the

exception of the smoke stack. The running board and running-board skirt are built as a part of the shroud, which is at no point rigidly attached to the boiler, but is held in lateral alignment by flexible connections to the top of the boiler. The running boards are supported from the main frames at the valve yokes and at the air-pump and feed-pump brackets. The rear end is supported from the side of the firebox by means of a sliding bracket connection which permits free movement of the boiler without strain on the running board.

The cab, except for the rounding of the corners on the front end, is essentially of standard vestibule construction in general use by the railroad. The roof ventilators have been depressed in the roof so that they are invisible from the ground. The cab is lined with Johns-Manville Flexboard.

The front of the engine is so designed that the coupler can be folded up when not in use and covered with a

Partial List of Specialties on the Canadian Pacific 4-4-4 Type Locomotives

Staybolts, flexible	Flannery
Trucks, Engine, trailing and tender	General Steel Castings Corp.
Driving-wheel centers (Boxpok-General Steel Castings)	Canadian Car & Foundry Co.
Driving-box cellars	Montreal Locomotive Works
Roller-bearing boxes, engine and tender	Canadian SKF Co., Ltd.
Drawbars, Unit Safety	Franklin Railway Supply Co.
Radial buffer (Type E-1)	Franklin Railway Supply Co.
Cylinder-cock operating device	T. McAvity & Sons
Cylinder-exhaust passage drain valve (World)	T. McAvity & Sons
Piston and valve rings	Hunt-Spiller
Metallic packings: Piston rod, valve stem, air compressor and steam end of feed-water pump	King type
Lubrication, motion and brake equipment	Alemite
Lubrication, main and side rod	Spee-D
Lubricators, guide bar (DV-4)	Nathan
Lubricators, flange	T. McAvity & Sons
Air brakes (Schedule 8ET)	Canadian Westinghouse Co., Ltd.
Clasp brakes, engine	American Brake Co. design
Clasp brakes, tender	American Steel Foundries
Air-compressor throttle valve	Canadian Westinghouse Co., Ltd.
Flexible coupling, steam-line	Barco Mfg. Co.
Draft gear, tender	Miner A5XB
Front cab windows (Thermosash, with Duolite glass)	Robert Mitchell Co.
Cab light (World B and C)	T. McAvity & Sons
Bell ringer (Taynold, Type B)	Railway & Engineering Specialty Corp.
Boiler blow-off cock	Everlasting Valve Model W
Throttle, multiple type	Superheater Co.
Gages: Boiler, stoker, feedwater heater	Sydney Smith
Gages: Steam-heat, signal, air-brake	Morrison
Injector, non-lifting (Hancock Type W)	T. McAvity & Sons
Injector checks	T. McAvity & Sons
Safety valves, bolted flange base	T. McAvity & Sons
Steam-heating reducing valve	Leslie Type AK
Miscellaneous valves	T. McAvity & Sons
Washout plugs	Huron type
Fire door (No. 8)	Franklin Railway Supply Co.
Grate bars and bearers, Chromite heat-resisting steel for	Hull Iron & Steel Foundry
Feedwater heater and pump (Elesco)	Superheater Co.
Power reverse gear	Barco type B-4
Tank-hose couplings	T-Z type
Tender underframe, water bottom	General Steel Castings Corp.
Classification lamp	Robert Mitchell Co.
Electric headlight (14-in. diam.)	Pyle-National Co.
Electric headlight generator	2—J. Stone & Co. 3—Pyle-National Co.

light removable panel. The hand-rail posts are of the Blunt type which simplify lining up the hand rail and provide for quick removal or replacement.

Brake Equipment

The locomotives are equipped with Westinghouse No. 8ET air-brake equipment with the engineer's brake valve and feed valves pedestal mounted. The engine and tender are equipped throughout with clasp brakes, with the exception of the lead wheels on the trailing truck, each of which has a single brake shoe. The engine-truck and trailing-truck brake cylinders are mounted on the trucks, two 10-in. by 10-in. cylinders on the engine truck and two 12-in. by 8-in. cylinders on the trailing truck. There are two 14-in. by 10-in. driver-brake cylinders, each operating the brake shoes on one pair of drivers. The braking ratio on the driving wheels is 80 per cent; on the rear trailing-truck wheels, 72 per cent, and on the engine and leading trailing-truck wheels, 45 per cent.

The tender is of the rectangular type, built up on a General Steel Castings water-bottom underframe. It is carried on two four-wheel trucks fitted with SKF roller bearings. The top of the tender back of the coal space is curved in at the sides to conform with the contour of the new passenger coaches with which the locomotives will be operated. The engine-tender connections include the Franklin Type E-1 radial buffer and Unit Safety type drawbars of forged nickel steel.

Finish

In finish the locomotive presents a striking appearance. The cowling about the smokebox and around the front end, and the sides and front of the cab are finished in black. The remainder of the cowling over the boiler is in planished steel. On a black field along the skirting around the running board is a wide band of Tuscan red, the standard coach color of the Canadian Pacific, which is separated from the black border by a stripe of gold. Below each cab side window is a panel of Tuscan red on which the Canadian Pacific shield is painted in colors. A large panel of Tuscan red on black is also employed on each side of the tender. The numbers and lettering are in gold.

Weight Saved in New Hiawatha Cars

(*Continued from page 472*)

car and in the ladies' lounge; in the men's lounge with grey rubber. Seats in the body of the car are covered with turquoise green plush.

The drawing-room parlor car is similar to the straight parlor car except that a 10-ft. drawing room has been provided which reduces the seating capacity to 22 in the body of the car. The men's lounge is, however, somewhat larger than in the straight parlor car, being about two feet longer and allowing five seats instead of four. The women's lounge also seats four. A total of seven persons can be seated in the drawing room.

The beaver-tail parlor car has a vestibule at the forward end and toilet rooms, clothes lockers, and baggage lockers are contained in the first 12 ft. of the car body. The passenger compartment is 47 ft. 10 in. long with seats for 26 persons. The rear compartment of this car, an observation lounge seating 12, is materially changed from the 1934 beaver-tail. On the exterior, the rear platform is omitted and the end rounded similar to the side of the car. This has lengthened the body of the car about one foot and permits placing an additional window between the emergency side door and rear end. The number of windows in the curved section has been increased from two to four. No buffer protrudes at the rear of this car.

Radios are installed in the tap room and the beaver-tail cars, being of the automotive type with automotive antennae mounted on the roof. The receivers are concealed and operated by the crew, or porter, as the case may be. The tap room has one speaker concealed in the ceiling cove and the beaver-tail has two speakers, one for the body of the car and one for the rear compartment, concealed in the ceiling cove.

W. F. Kiesel, Jr., Retires

Forty-eight years with Pennsylvania in Mechanical Engineering Department

W. F. Kiesel, Jr., mechanical engineer of the Pennsylvania Railroad during the past 17 years, retired from active service on September 30, 1936. His entire service of more than 48 years with that company was in the department of mechanical engineering design. For the greater part of this period he was an important factor in that department, since he was promoted to the position of chief draftsman more than 37 years ago, at about the time when interest was being stimulated in the possible use of all-steel gondola and hopper cars for the coal and ore traffic.

He took a leading and important part in steel freight car design from the very beginning. The tendency at that time was to turn out extremely light designs. Mr. Kiesel understood the importance of this from the standpoint of operating economies, but he also recognized the necessity of keeping down maintenance costs and insuring the continued serviceability of the equipment. The Pennsylvania designs were at first criticized for their strength and high weights, but in the long run they were found to be better adapted for the service and Mr. Kiesel's judgment was vindicated. His work on the Pennsylvania, and also as chairman of the Car Construction Committee of the Mechanical Division of the American Railway Association and its predecessor, during the period from 1912 to 1927, had a large influence on the improvement in the design of freight cars, not only on his own road, but on all American railroads. His contribution in the field of passenger car design was also of great importance, bridging over the period from the old all-wooden construction to the modern, all-steel construction, with the refinements and improvements which have made American passenger car service today the safest means of travel.

W. F. Kiesel, Jr.

Mr. Kiesel's contributions to the improvement in locomotive design, both steam and electric, are also of unusual value. In this development, from the old plain locomotive, as it used to be called, to the modern type, with all its refinements, Mr. Kiesel capitalized on the results of the extensive work which was done on the locomotive testing plant at Altoona, as well as facilities for making thorough and comprehensive service tests.

It is rather unusual on American railroads, for one man to have had such long and active experience in the field of equipment design, and to have exercised such a large influence not only on his own road, but upon the American railroads as a whole. In more recent years Mr. Kiesel has given much attention to the design and improvement of electric locomotives, resulting in the designs which are now operating so successfully in the New York-Washington service. Mr. Kiesel has been granted a total of 135 patents on improvements in the design of or devices for locomotives and cars. Among his more recent contributions are the limited cut-off and improvements in the design of front end drafting devices.

William Frederick Kiesel, Jr., was born at Scranton, Pa., September 1, 1866. His father, an officer of the Lackawanna Iron & Coal Company, was identified with that company for 50 years, from its very beginnings to its removal from Scranton to Buffalo, when it became known as the Lackawanna Iron & Steel Company. Mr. Kiesel attended private schools at Scranton, Pa., and served an apprenticeship in the machinist trade in the shops of the Lackawanna Iron & Coal Company. He then took a preparatory course and later entered Lehigh University, from which he was graduated in 1887 with the degree of mechanical engineer. After graduation he assisted in a test of the locomotive "H. S. Goodwin" on the Lehigh Valley Railroad. He then worked at the blast furnaces of the Lackawanna Iron & Steel Company, but on April 9, 1888, resigned to become a draftsman in the office of the mechanical engineer of the Pennsylvania at Altoona, Pa. He was promoted to chief draftsman, March 1, 1899; to assistant engineer, July 1, 1900; assistant mechanical engineer, September 1, 1902, and mechanical engineer on February 1, 1910.

Mr. Kiesel was honored by the Franklin Institute in 1928 with the George Henderson Medal. He was made an Honorary Doctor of Engineering by Lehigh University in 1928. He is a member of the American Society of Mechanical Engineers and in addition to his leadership of the Car Construction Committee of the Mechanical Division already mentioned, served as chairman of the committees on Main and Side Rods and Springs for Freight Car Trucks.

Link Motion Valve Gear

Part III

By J. Edgar Smith*

Variable lead—Limited cutoff—Reference tables giving valve settings for 8-in., 8 1/4-in. and 8 1/2-in. valve travel

SOMETIMES it is desired to arrange for variable lead in the design of the valve gear for locomotives used in fast passenger service. By doing so, the recommended lead of 5/16 in can be provided for in running cutoff, while in full gear a lead of 1/8 in. can be obtained. This change in lead, with the same travel and lap, provides a later maximum cutoff in full gear and consequently a greater starting power.

The most commonly used method of altering the Walschaert gear to obtain variable lead is that by which the gear is laid out as usual and the lead reduced a definite amount in full gear forward by lengthening the eccentric crank (for inside admission piston valves). This delay, of course, becomes an advance in back-up motion and the lead is consequently increased instead of reduced. This is not of any great importance since the variable lead is almost never used on locomotives which are required to operate to any great extent in backing up.

There are other methods of obtaining variable lead but they all require extra parts and while they will give the same reduction in lead in full gear for either forward or backward motion, the cost and maintenance of the extra parts is hardly justifiable. For these reasons only the first mentioned method will be considered here.

In laying out the gear for variable lead, the same method as described in Part II should be followed, except that the lead should be taken at 3/8 in. After the gear has been laid out and the lengths and proportions of all the parts have been determined, the eccentric crank should be lengthened a sufficient amount, without changing the eccentric throw, to pull the valve stem back 1/4 in., giving 1/8 in. lead in full gear. This can best be done on the layout. With this reduction of 1/4 in. in lead in full gear, the lead will be reduced approximately 1/16 in at 25 per cent cutoff, giving 5/16 in. lead in running position.

* Lima, Ohio.

Limited Cutoff

No attempt will be made here to study the conditions which it is necessary to consider in order to determine whether or not limited cutoff is to be provided for and to what extent the maximum cutoff in full gear is to be limited. So many factors are involved that they cannot be thoroughly discussed within the limitations of this article. Also, the purpose of this article is to suggest a method of laying out the Walschaert gear to meet definite operating conditions and not to analyze the operating requirements of the locomotive as a whole. In other words, with the total weight, tractive force, driving-wheel diameter, cylinder proportions and the boiler pressure decided on and to what extent the cutoff is to be limited, we are here concerned with the

Table I—Valve Settings for 8-In. Valve Travel

Lap, in.	Max. cutoff, full gear, per cent	Port opening, in., for per cent cutoffs: Full gear	66	50	33	25	Equiv. eccentricity, in.
With 5/16-In. Lead							
2 5/8	51.5	1 3/8	....	....	25/32	19/32	2 23/32
2 1/2	55.6	1 1/2	....	....	49/64	37/64	2 27/32
2 3/8	59.9	1 5/8	....	....	47/64	9/16	2 31/32
2 1/4	63.7	1 3/4	....	....	45/64	35/64	3 5/64
2 1/8	67.4	1 7/8	....	....	43/64	17/32	3 11/64
2	71.0	2	....	....	21/32	33/64	3 17/64
1 7/8	74.1	2 1/8	....	....	5/8	31/64	3 11/32
1 3/4	77.2	2 1/4	....	....	19/32	15/32	3 27/64
1 5/8	80.0	2 3/8	1 7/16	29/32	9/16	29/64	3 1/2
1 1/2	82.7	2 1/2	1 11/32	55/64	35/64	7/16	3 9/16
1 7/16	84.1	2 9/16	1 19/64	53/64	17/32	27/64	3 19/32
1 3/8	85.3	2 5/8	1 17/64	51/64	33/64	27/64	3 5/8
1 5/16	86.5	2 11/16	1 7/32	25/32	1/2	13/32	3 21/32
1 1/4	87.7	2 3/4	1 3/16	3/4	31/64	13/32	3 11/16
1 3/16	88.6	2 13/16	1 1/8	23/32	31/64	25/64	3 45/64
1 1/8	89.7	2 7/8	1 5/64	45/64	15/32	25/64	3 47/64
With 1/4-In. Lead							
2 5/8	52.6	1 3/8	....	....	3/4	9/16	2 25/32
2 1/2	56.8	1 1/2	....	....	23/32	35/64	2 29/32
2 3/8	60.9	1 5/8	....	....	11/16	33/64	3 1/64
2 1/4	64.7	1 3/4	....	....	43/64	1/2	3 1/8
2 1/8	68.2	1 7/8	....	....	41/64	31/64	3 7/32
2	71.6	2	....	....	39/64	15/32	3 5/16
1 7/8	75.0	2 1/8	....	....	37/64	29/64	3 25/64
1 3/4	77.9	2 1/4	....	....	35/64	7/16	3 15/32
1 5/8	80.9	2 3/8	1 3/8	55/64	17/32	13/32	3 17/32
1 1/2	83.6	2 1/2	1 21/64	13/16	1/2	25/64	3 19/32
1 7/16	84.7	2 9/16	1 9/32	25/32	31/64	25/64	3 5/8
1 3/8	86.0	2 5/8	1 1/4	3/4	15/32	3/8	3 21/32
1 5/16	87.2	2 11/16	1 13/64	47/64	15/32	23/64	3 11/16
1 1/4	88.3	2 3/4	1 5/32	45/64	29/64	23/64	3 45/64
1 3/16	89.4	2 13/16	1 7/64	43/64	7/16	11/32	3 47/64

Lap, in.	Max. cutoff, full gear per cent	Port opening, in., for per cent cutoffs: Full gear	66	50	33	25	Equiv. eccentricity, in.
With 3/16-In. Lead							
2 3/4	49.4	1 1/4	....	....	23/32	17/32	2 23/32
2 5/8	53.7	1 3/8	....	....	11/16	33/64	2 27/32
2 1/2	57.7	1 1/2	....	....	43/64	1/2	2 31/32
2 3/8	61.9	1 5/8	....	....	21/32	31/64	3 5/64
2 1/4	65.6	1 3/4	....	....	5/8	15/32	3 11/64
2 1/8	69.1	1 7/8	....	....	19/32	7/16	3 17/64
2	72.5	2	....	....	9/16	27/64	3 11/32
1 7/8	75.6	2 1/8	....	....	35/64	13/32	3 27/64
1 3/4	78.6	2 1/4	....	....	33/64	25/64	3 1/2
1 5/8	81.4	2 3/8	1 21/64	13/16	31/64	3/8	3 9/16
1 1/2	84.1	2 1/2	1 5/16	3/4	29/64	11/32	3 5/8
1 7/16	85.4	2 9/16	1 17/64	47/64	7/16	11/32	3 21/32
1 3/8	86.5	2 5/8	1 15/64	45/64	27/64	21/64	3 11/16
1 5/16	87.6	2 11/16	1 3/16	43/64	27/64	21/64	3 45/64
1 1/4	88.7	2 3/4	1 9/64	21/32	13/32	5/16	3 47/64
1 3/16	89.9	2 13/16	1 3/32	5/8	25/64	5/16	3 49/64
With 1/8-In. Lead							
2 3/4	50.6	1 1/4	....	....	11/16	1/2	2 25/32
2 5/8	54.9	1 3/8	....	....	21/32	31/64	2 29/32
2 1/2	58.8	1 1/2	....	....	41/64	15/32	3 1/64
2 3/8	62.9	1 5/8	....	....	39/64	7/16	3 1/8
2 1/4	66.6	1 3/4	....	....	37/64	27/64	3 7/32
2 1/8	70.0	1 7/8	....	....	35/64	13/32	3 5/16
2	73.5	2	....	....	17/32	25/64	3 25/64
1 7/8	76.5	2 1/8	....	....	1/2	23/64	3 15/32
1 3/4	79.4	2 1/4	....	....	15/32	11/32	3 17/32
1 5/8	82.2	2 3/8	1 17/64	49/64	7/16	21/64	3 19/32
1 1/2	84.8	2 1/2	1 19/64	23/32	13/32	5/16	3 21/32
1 7/16	86.0	2 9/16	1 1/4	11/16	13/32	19/64	3 11/16
1 3/8	87.2	2 5/8	1 13/64	21/32	25/64	19/64	3 45/64
1 5/16	88.3	2 11/16	1 5/32	5/8	3/8	9/32	3 47/64
1 1/4	89.4	2 3/4	1 1/8	39/64	23/64	17/64	3 49/64

valve events which will achieve the best possible performance under these conditions.

The method of determining valve characteristics as described in Part I and the method of laying out the gear as described in Part II may be used for the limited-cutoff design as well as the full-cutoff design. However, it will be found that, with the maximum cutoff in full gear limited to around 60 per cent, a large link circle diameter (18 in. to 19 in.) will be necessary and it will be necessary to use the full 45 deg. link throw. Also, owing to the fact that the greater portion of the valve movement is derived from the effect of the combination lever, it will be found that the angle formed by the combination lever in its extreme positions, with the radius rod in mid position on the link, will be somewhat less than the limit of 60 deg. It is advisable, therefore, to lay off the lap plus lead plus 1/32 in. each side of the center of the valve-stem crosshead and through these points and the bottom connections of the combination lever which were located as described in Fig. 7, draw center lines which will intersect above the center of the valve stem. The distance *a* should be taken from this layout rather than calculated according to the formula.*

To aid in the selection of the valve events for the locomotive under consideration, the tables of maximum cutoffs in full gear, port openings for the different running cutoff positions according to the class of service and the equivalent eccentricity are shown for the valve travels of 8 in., 8 1/4 in. and 8 1/2 in.

Table II—Valve Settings for 8 1/4-In. Valve Travel

Lap, in.	Max. cutoff, full gear, per cent	Port opening, in., for per cent cutoffs: Full gear	66	50	33	25	Equiv. eccentricity, in.
		With 5/16-In. Lead					
2 3/4	50.2	1 3/8	....	....	13/16	39/64	2 49/64
2 5/8	54.6	1 1/2	....	....	25/32	19/32	2 57/64
2 1/2	58.5	1 5/8	....	....	49/64	37/64	3 1/64
2 3/8	62.3	1 3/4	....	....	47/64	9/16	3 1/8
2 1/4	66.2	1 7/8	....	....	45/64	35/64	3 15/64
2 1/8	69.5	2	....	....	43/64	17/32	3 21/64
2	72.8	2 1/8	....	....	21/32	33/64	3 27/64
1 7/8	75.9	2 1/4	....	....	5/8	31/64	3 1/2
1 3/4	78.7	2 3/8	....	....	19/32	15/32	3 37/64
1 5/8	81.3	2 1/2	1 7/16	29/32	9/16	29/64	3 41/64
1 1/2	84.0	2 5/8	1 11/32	55/64	35/64	7/16	3 45/64
1 7/16	85.0	2 11/16	1 19/64	53/64	17/32	27/64	3 47/64
1 3/8	86.3	2 3/4	1 17/64	51/64	33/64	27/64	3 49/64
1 5/16	87.4	2 13/16	1 7/32	25/32	1/2	13/32	3 51/64
1 1/4	88.4	2 7/8	1 3/16	3/4	31/64	13/32	3 53/64
1 3/16	89.5	2 15/16	1 1/8	23/32	31/64	25/64	3 27/32
		With 1/4-In. Lead					
2 3/4	51.3	1 3/8	....	....	49/64	37/64	2 53/64
2 5/8	55.7	1 1/2	....	....	3/4	9/16	2 61/64
2 1/2	59.5	1 5/8	....	....	23/32	35/64	3 5/64
2 3/8	63.3	1 3/4	....	....	11/16	33/64	3 3/16
2 1/4	66.9	1 7/8	....	....	43/64	1/2	3 9/32
2 1/8	70.4	2	....	....	41/64	31/64	3 3/8
2	73.5	2 1/8	....	....	39/64	15/32	3 29/64
1 7/8	76.7	2 1/4	....	....	37/64	29/64	3 35/64
1 3/4	79.4	2 3/8	....	....	35/64	7/16	3 39/64
1 5/8	82.1	2 1/2	1 3/8	55/64	17/32	13/32	3 43/64
1 1/2	84.6	2 5/8	1 21/64	13/16	1/2	25/64	3 47/64
1 7/16	85.7	2 11/16	1 9/32	25/32	31/64	25/64	3 49/64
1 3/8	86.9	2 3/4	1 1/4	3/4	15/32	3/8	3 51/64
1 5/16	88.0	2 13/16	1 13/64	47/64	15/32	23/64	3 53/64
1 1/4	89.0	2 7/8	1 5/32	45/64	29/64	23/64	3 27/32
1 3/16	90.0	2 15/16	1 7/64	43/64	7/16	11/32	3 55/64
		With 3/16-In. Lead					
2 3/4	52.5	1 3/8	....	....	23/32	17/32	2 57/64
2 5/8	56.8	1 1/2	....	....	11/16	33/64	3 1/64
2 1/2	60.6	1 5/8	....	....	43/64	1/2	3 1/8
2 3/8	64.3	1 3/4	....	....	21/32	31/64	3 15/64
2 1/4	68.0	1 7/8	....	....	5/8	15/32	3 21/64
2 1/8	71.4	2	....	....	19/32	7/16	3 27/64
2	74.4	2 1/8	....	....	9/16	27/64	3 1/2
1 7/8	77.5	2 1/4	....	....	35/64	13/32	3 37/64
1 3/4	80.1	2 3/8	....	....	33/64	25/64	3 41/64
1 5/8	82.7	2 1/2	1 21/64	13/16	31/64	3/8	3 45/64
1 1/2	85.2	2 5/8	1 5/16	3/4	29/64	11/32	3 49/64
1 7/16	86.3	2 11/16	1 17/64	47/64	7/16	11/32	3 51/64
1 3/8	87.5	2 3/4	1 15/64	45/64	27/64	21/64	3 53/64
1 5/16	88.6	2 13/16	1 3/16	43/64	27/64	21/64	3 27/32
1 1/4	89.5	2 7/8	1 9/64	21/32	13/32	5/16	3 55/64
		With 1/8-In. Lead					
2 3/4	53.7	1 3/8	....	....	11/16	1/2	2 61/64
2 5/8	57.9	1 1/2	....	....	21/32	31/64	3 5/64
2 1/2	61.7	1 5/8	....	....	41/64	15/32	3 3/16
2 3/8	65.4	1 3/4	....	....	39/64	7/16	3 9/32
2 1/4	69.0	1 7/8	....	....	37/64	27/64	3 3/8
2 1/8	72.2	2	....	....	35/64	13/32	3 29/64
2	75.3	2 1/8	....	....	17/32	25/64	3 35/64
1 7/8	78.3	2 1/4	....	....	1/2	23/64	3 39/64
1 3/4	81.0	2 3/8	....	....	15/32	11/32	3 45/64
1 5/8	83.4	2 1/2	1 17/64	49/64	7/16	21/64	3 47/64
1 1/2	85.8	2 5/8	1 19/64	23/32	13/32	5/16	3 51/64
1 7/16	87.0	2 11/16	1 1/4	11/16	13/32	19/64	3 53/64
1 3/8	88.2	2 3/4	1 15/64	21/32	25/64	19/64	3 27/32
1 5/16	89.2	2 13/16	1 5/32	5/8	3/8	9/32	3 55/64
1 1/4	90.0	2 7/8	1 1/8	39/64	23/64	17/64	3 57/64

Table III—Valve Settings for 8 1/2-In. Valve Travel

Lap, in.	Max. cutoff, full gear, per cent	Port opening, in., for per cent cutoffs: Full gear	66	50	33	25	Equiv. eccentricity, in.
		With 5/16-In. Lead					
2 3/4	53.0	1 1/2	....	....	13/16	39/64	2 15/16
2 5/8	57.0	1 5/8	....	....	25/32	19/32	3 5/64
2 1/2	61.0	1 3/4	....	....	49/64	37/64	3 3/16
2 3/8	64.6	1 7/8	....	....	47/64	9/16	3 19/64
2 1/4	68.0	2	....	....	45/64	35/64	3 25/64
2 1/8	71.4	2 1/8	....	....	43/64	17/32	3 31/64
2	74.2	2 1/4	....	....	21/32	33/64	3 9/16
1 7/8	77.4	2 3/8	....	....	5/8	31/64	3 41/64
1 3/4	79.9	2 1/2	....	....	19/32	15/32	3 23/32
1 5/8	82.4	2 5/8	1 7/16	29/32	9/16	29/64	3 25/32
1 1/2	84.8	2 3/4	1 11/32	55/64	35/64	7/16	3 27/32
1 7/16	85.9	2 13/16	1 19/64	53/64	17/32	27/64	3 7/8
1 3/8	87.0	2 7/8	1 17/64	51/64	33/64	27/64	3 29/32
1 5/16	88.0	2 15/16	1 7/32	25/32	1/2	13/32	3 59/64
1 1/4	89.1	3	1 3/16	3/4	31/64	13/32	3 61/64
1 3/16	90.0	3 1/16	1 1/8	23/32	31/64	25/64	3 63/64
		With 1/4-In. Lead					
2 7/8	50.1	1 3/8	....	....	51/64	19/32	2 7/8
2 3/4	54.2	1 1/2	....	....	49/64	37/64	3 1/64
2 5/8	58.2	1 5/8	....	....	3/4	9/16	3 1/8
2 1/2	62.1	1 3/4	....	....	23/32	35/64	3 15/64
2 3/8	65.4	1 7/8	....	....	11/16	33/64	3 11/32
2 1/4	68.8	2	....	....	43/64	1/2	3 7/16
2 1/8	72.0	2 1/8	....	....	41/64	31/64	3 17/32
2	75.1	2 1/4	....	....	39/64	15/32	3 39/64
1 7/8	78.0	2 3/8	....	....	37/64	29/64	3 11/16
1 3/4	80.6	2 1/2	....	....	35/64	7/16	3 3/4
1 5/8	83.0	2 5/8	1 3/8	55/64	17/32	13/32	3 13/16
1 1/2	85.4	2 3/4	1 21/64	13/16	1/2	25/64	3 7/8
1 7/16	86.6	2 13/16	1 9/32	25/32	31/64	25/64	3 29/32
1 3/8	87.5	2 7/8	1 1/4	3/4	15/32	3/8	3 59/64
1 5/16	88.6	2 15/16	1 13/64	47/64	15/32	23/64	3 61/64
1 1/4	89.6	3	1 5/32	45/64	29/64	23/64	3 63/64
		With 3/16-In. Lead					
2 7/8	51.2	1 3/8	....	....	3/4	9/16	2 15/16
2 3/4	55.2	1 1/2	....	....	23/32	17/32	3 5/64
2 5/8	59.0	1 5/8	....	....	11/16	33/64	3 3/16
2 1/2	63.0	1 3/4	....	....	43/64	1/2	3 19/64
2 3/8	66.3	1 7/8	....	....	21/32	31/64	3 25/64
2 1/4	69.6	2	....	....	5/8	15/32	3 31/64
2 1/8	72.8	2 1/8	....	....	19/32	7/16	3 9/16
2	75.9	2 1/4	....	....	9/16	27/64	3 41/64
1 7/8	78.8	2 3/8	....	....	35/64	13/32	3 23/32
1 3/4	81.2	2 1/2	....	....	33/64	25/64	3 25/32
1 5/8	83.7	2 5/8	1 21/64	13/16	31/64	3/8	3 27/64
1 9/16	84.8	2 11/16	1 3/8	25/32	15/32	23/64	3 7/8
1 1/2	86.0	2 3/4	1 5/16	3/4	29/64	11/32	3 29/32
1 7/16	87.2	2 13/16	1 17/64	47/64	7/16	11/32	3 59/64
1 3/8	88.2	2 7/8	1 15/64	45/64	27/64	21/64	3 61/64
1 5/16	89.1	2 15/16	1 3/16	43/64	27/64	21/64	3 63/64
1 1/4	90.0	3	1 9/64	21/32	13/32	5/16	4
		With 1/8-In. Lead					
2 7/8	52.2	1 3/8	....	....	23/32	33/64	3 1/64
2 3/4	56.2	1 1/2	....	....	11/16	1/2	3 1/8
2 5/8	60.0	1 5/8	....	....	21/32	31/64	3 15/64
2 1/2	63.6	1 3/4	....	....	41/64	15/32	3 11/32
2 3/8	67.3	1 7/8	....	....	39/64	7/16	3 7/16
2 1/4	70.4	2	....	....	37/64	27/64	3 17/32
2 1/8	73.6	2 1/8	....	....	35/64	13/32	3 39/64
2	76.5	2 1/4	....	....	17/32	25/64	3 11/16
1 7/8	79.4	2 3/8	....	....	1/2	23/64	3 3/4
1 3/4	81.8	2 1/2	....	....	15/32	11/32	3 13/16
1 5/8	84.3	2 5/8	1 17/64	49/64	7/16	21/64	3 7/8
1 9/16	85.4	2 11/16	1 7/32	47/64	7/16	5/16	3 29/32
1 1/2	86.5	2 3/4	1 19/64	23/32	13/32	5/16	3 59/64
1 7/16	87.5	2 13/16	1 1/4	11/16	13/32	19/64	3 61/64
1 3/8	88.6	2 7/8	1 13/64	21/32	25/64	19/64	3 63/64
1 5/16	89.6	2 15/16	1 5/32	5/8	3/8	9/32	4

* See page 427 of the October, 1936, issue of the *Railway Mechanical Engineer.*

Failures of

Locomotive Parts*

By F. H. Williams†

It is said that "cranks make the world go 'round'." Certainly they make the wheels go around on a locomotive, although the crank has been made such an intrinsic part of the wheel center that it is hardly noticed by the average person. The crank pin is the connecting link, or one of the connecting links between the steam power and the body of the locomotive, which hauls passengers and freight over this vast continent. The power given up in the expansion of the steam forces the piston to and fro in the cylinder. This, in turn, through the piston rod, forces the crosshead back and forth, and through the rods and crank pins, drives the locomotive wheels around and the locomotive starts off on its journey.

While the other parts of the locomotive all have their special functions to perform, the crank pin is of primary importance. When it fails the locomotive stops—either on the track or in the ditch. The crank pin is a round shaft with several reductions in diameter; it is of comparatively short length, depending upon its location and the size of the locomotive. One end is pressed into the wheel center and the other is turned to suitable diameters and arranged with various devices for keeping the rods in place on the outer portion of the pin. In this article, while some of the statements are applicable to the entire pin, we shall confine our attention largely to that portion of the crank pin in the wheel center, and adjacent to the main side rod fit of the crank pin.

There are two types of failures of this portion of the pin: (1) those that fail in the wheel center, and (2) those that fail in the fillet next to the wheel fit. Failures due to defects in the steel, its composition and heat treatment, are comparatively rare and will not be considered in this article.

Failures in the Wheel Fit

Many failures of crank pins occur in the wheel fit, and usually the nature of these fractures is such as to bewilder the uninitiated. For instance, the fractured end may show one-half of coarse texture and the other half of fine texture; it would appear at first glance that the grain of one-half of the steel was fine and the other half coarse, whereas the steel is generally actually uniform in structure—either coarse or fine. Then, again, one part of the fracture may appear very dark and rusty, whereas the balance is bright. This would seem to indicate that the steel has a flaw to the extent of the dark area, but this conclusion is wrong. Possibly we can better understand the nature of a fatigue crack by outlining a few well known definitions of terms used in connection with it.

Endurance Limit.—The maximum stress to which material may be subjected an indefinitely large number of times without causing failure.

Yield Point.—The stress corresponding to some definite, permanent deformation of the steel.

Fatigue.—It has been found that for all materials failure can be brought about by the application of a load less than the static elastic limit, provided the stress is repeated often enough.

Fatigue Cracks.—Cracks due to fatigue.

Stress-Corrosion Cracks.—Cracks due to a combination of stresses (reverse) and corrosion.

* Articles on failures of side rods and tires appeared in the *Railway Mechanical Engineer* for May, June, July and October of the current year.
† Assistant test engineer, Canadian National Railways.

In previous articles we have illustrated many fatigue cracks of side rods and driving wheel tires and have pointed out that the fine part of the fracture is the result of a crack starting from minute beginnings and working slowly across the section; it becomes coarser as it progresses and the section which finally gives way is quite coarse in structure. The fine, dark surface is caused by the ends of the cracked portion rubbing together and literally polishing themselves on each other. This surface becomes slightly corroded and darkens, so that the uninitiated is led to believe that the part has a flaw in it, whereas, in fact, the failure is caused by a fatigue crack starting from a small tool or other mark, developing gradually and finally resulting in the complete fracture. It will be found that the steel has not been stressed beyond the elastic limit or yield point, but that the fatigue crack was caused by the reverse stresses to which the steel is subjected. Examinations under the microscope fail to reveal any deformation in the grain structure, yet the crack caused by reverse stresses has advanced steadily across the section.

Tests for the endurance limit of a steel are made with highly polished specimens; in the case of ordinary carbon crank pin steel, the endurance limit runs about 40,000 lb. per sq. in., or possibly a little lower, perhaps 36,000 lb. per sq. in. Let us not forget, however, that the endurance test was made on a highly polished test specimen. Roughly, it may be stated that a tool mark 1/64 in. deep will cut the endurance limit to 50 per cent of its proper value, or, say, around 18,000 lb.; corrosion also will cause similar results. With this as a backgrounds, let us examine some typical fractures of crank pins.

One Type of Failure

The fracture end of a crank pin that failed in service is shown in Fig. 1. The upper part of the fracture, about one-third of the total cross section area of the pin, is polished, and the lower part is coarse. The polished area represents the fatigue crack proper and the coarser part indicates the more rapid extension of the crack and the final break when the steel had reached a stress greater than its elastic limit and the strength of the remainder of the metal in line with the fracture. It will be noted that the edges of the fracture in the starting of the fatigue crack at the top, are frilled, which indicates that the fracture started from a series of small cracks, all on different planes, eventually uniting into one large fatigue crack, the progressive lines of which and the path of which are shown in the illustration.

The finish of the wheel fit of this crank pin is shown in Fig. 2. This illustration is magnified, but the tool marks on the specimen are quite pronounced. The pin was applied August 28, 1934, and failed May 10, 1936, after a service of about 106,732 miles. It would not be strictly correct to say that it failed because of the tool marks, nor would it be correct to say that it failed from stress-corrosion cracks. Yet it is certain that one or the other, or both, caused the starting of the fatigue crack which resulted in the final failure of the pin.

I believe that many times this mileage can be obtained with a properly finished crank pin. Between 500,000 and 1,000,000 miles is a reasonable service requirement, and yet here is a case where complete failure occurred

FIG. 1

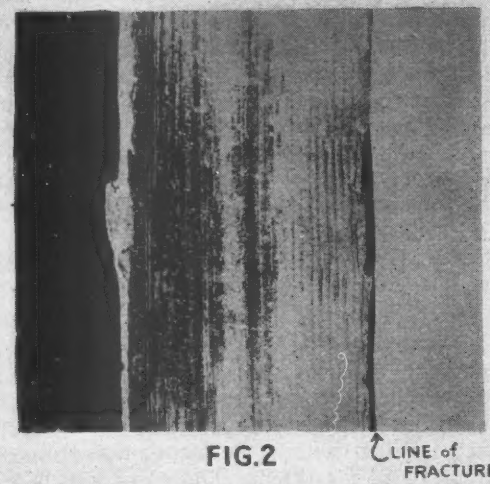


FIG. 2

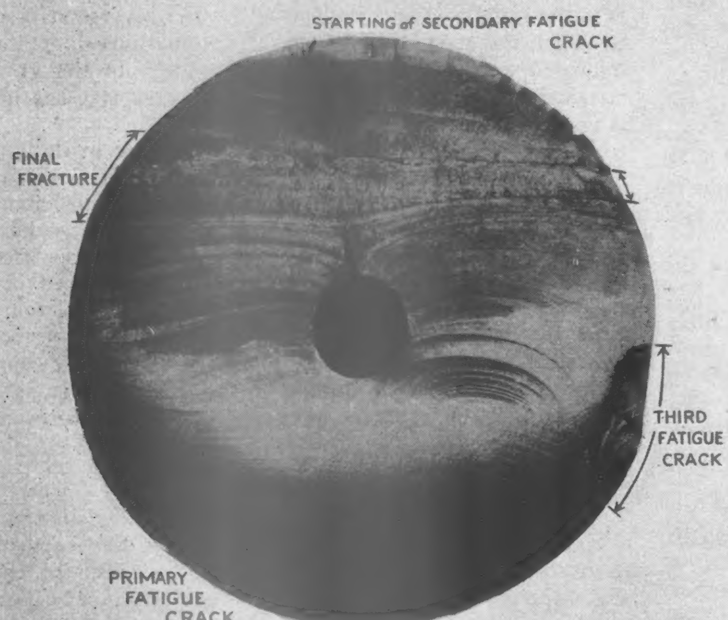


FIG. 3

FIG. 4

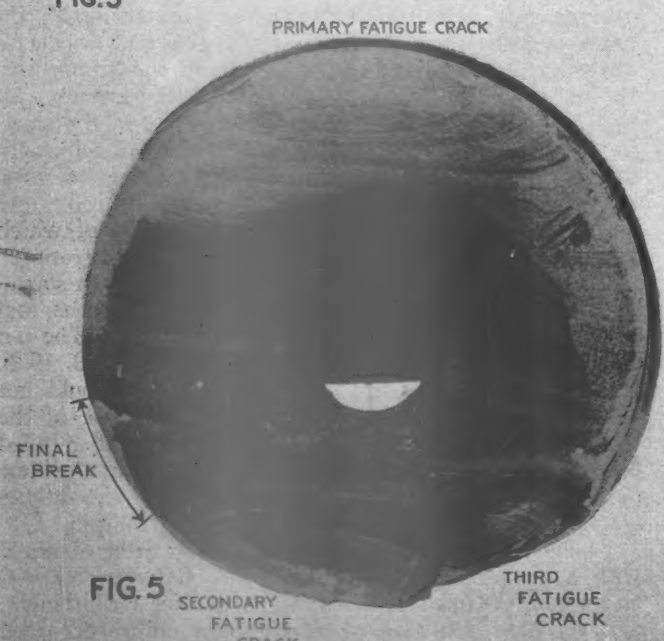


FIG. 5

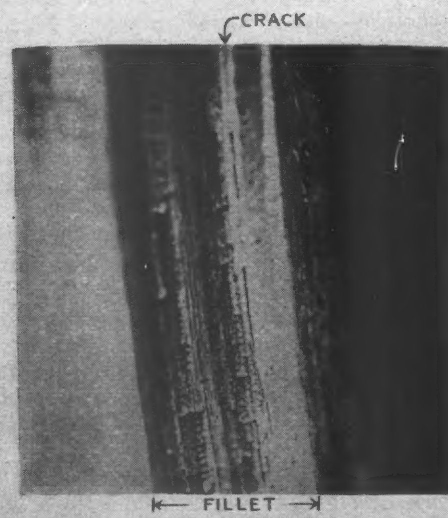


FIG. 6

at a little more than 100,000 miles. I am sure that even this low limit was high before attention was given to turning the pins with a better finish.

We have two things to contend with—rough finish and corrosion. Exactly what can we do to overcome them? Many suggestions have been tried, but the writer advocates the use of a method which he believes originated in Germany. It is by undercutting the surface of the crank pin in the wheel fit from .003 to .005, for perhaps 1/4 in to 1/2 in. in width, or several undercuts of shorter width, the extent of the undercutting to depend upon the design.

The rolling of the surface of the metal on the wheel fit is advocated by some authorities. With this process the wheel fit is prepared by machining or grinding, or both, and is then rolled for its full length. This is an improvement, but I believe the undercutting will be better; or if the rolling is limited to the same widths as the undercutting, it might be a step in the right direction and possibly be an improvement over the undercutting. This undercutting or under-rolling is to relieve frictional stresses that set up corrosion and reduce the endurance limit values to so low a point as to result in less than 25 per cent service from the pin.

This is a pretty strong statement to make and requires an explanation. When we prepare a crank pin for the wheel fit, it is turned, perhaps ground, and is pressed into the wheel center. When the locomotive goes into service the pin is subjected to reverse stresses, and if there is a tool mark, these stresses instead of being spread over a large surface concentrated in the bottom of the tool mark and shortly a fatigue crack starts. Or if the finish is free from tool marks or other defects, there is a working of the surface of the wheel fit under pressure, and frictional corrosion takes place; stress-corrosion cracks may start, which develop into fatigue cracks and result in eventual failure. By undercutting small widths of the crank pin fit or under-rolling similar distances, we have a surface with only one type of stress and not two stresses compounded, as is the case with the straight crank pin fit. The surface of the pin which is not undercut is subjected to compression stresses, but not to tensile stresses; the undercut portion on the other hand is subjected to tensile stresses, but not to compression stresses. We have thus reduced the range of the stress on the crank pin surface and have eliminated frictional corrosion where there were tensile stresses. If the reduced section made by the undercutting is free from tool marks and is polished, the possibility of fatigue cracks starting will be eliminated.

The failure illustrated in Figs. 1 and 2 is typical of hundreds of similar failures and the savings which could be effected by greater care in machining are enormous.

Fig. 1—Fractured end of crank pin. Upper one-third is of fine texture, somewhat polished, and represents the extent of fatigue crack. This crack developed from the series of small cracks at the top. Fig. 2—Micro-photograph showing finish of wheel fit of crank pin illustrated in Fig. 1. The line of fracture is at the right. Note the roughness of machine finish. Fig. 3—Fatigue cracks started in three places. Apparently the primary one was at the bottom, the secondary one at the top, and the third one at the side to the right. Complications are indicated by the progress of the break between the third fatigue crack and the center of the pin. The fatigue cracks extended through the greater part of the area before the final break. Fig. 4—Micro-photograph showing the rough machined surface of the wheel fit of the crank pin shown in Fig. 3. Fig. 5—Break caused by rough finished fillet adjacent to the wheel fit. Fig. 6—Micro-photograph showing rough machine tool finish in the fillet of the crank pin shown in Fig. 5.

When I started the campaign against rough machine work in our shops I was asked, "What do you want—a microscopic finish?" Conditions have improved and yet we must constantly strive for better finish, and still better finish, and then some plan to protect the better finish. Undercutting or under-rolling should accomplish this. Complete, perfect finish or rolling will not entirely accomplish the purpose, because of corrosion (either wet or dry corrosion); undercutting or under-rolling will afford additional protection.

Another interesting fracture is shown in Fig. 3. This crank pin was applied October 25, 1932, and failed May 29, 1936, less than four years later. Here we have an interesting series of fatigue cracks, all starting from tool marks, the roughness of which is shown in Fig. 4. This is not an unusual case and yet men will be found condoning, defending and ignoring such workmanship in all walks of mechanical life. I have even had a watch repaired that showed file marks comparatively as bad as the tool marks illustrated in Fig. 4, and yet the watchmaker wondered why the watch did not keep good time.

The fatigue cracks started in several places in the fracture shown in Fig. 3, and apparently the section was cracked to about 90 per cent of its area before the pin finally failed. This indicates that the steel was excellent and that the rough machining was undoubtedly the sole cause of the failure. On the other hand, it must be understood that we have no actual means of determining how much corrosion enters into the cause of such a failure, since the rough grooves on the surface of the wheel fit of the pin were no doubt affected by corrosion. Still they are too deep to charge the failure to other than the machining, even though corrosion was a factor.

Second Type of Failures

There is another type of failure which is quite common with crank pins. These occur because of the rough finished fillets adjacent to the wheel fit. A large reduction in the number of such failures has been made by improving the finish of these fillets. An illustration of such a failure is shown in Figs. 5 and 6. A study of Fig. 5, the fractured end of the pin, indicates that there are several separate fatigue cracks, which finally converge and cause failure. As a matter of fact, the pin stood up until well over 90 per cent of the section was cracked through before the final failure took place. All of the fatigue cracks started from the fillet. The enlargement of this fillet in Fig. 6 shows the tool marks and the torn surface of the metal, which obviously was not suitable for resistance to failure from fatigue. Incidentally, while a rough finish of this sort is sometimes found on fillets of new pins, it is usually the result of work which is done when the pin is returned to the shops, because of scoring or for other reasons. Under such conditions it may be difficult to finish the pin properly. This, however, is poor economy, since the pin is quite likely to fail in service.

A solid pin which failed in service is shown in Figs. 7 and 8. Apparently the material was not quite as good as that shown in previous illustrations, since the pin failed when only a little over two-thirds of the section had cracked. The poor machine finish, however, which is illustrated in Fig. 8, was probably mainly responsible for the failure. It will be noted that in Fig. 7 there is considerable frilling near the start of the fatigue crack. This is due to the torn surface which interrupted the progress of the fatigue crack and started it off in different planes as it progressed.

The machine tool, in this instance, was not cutting properly and no doubt was set at the wrong angle and ground with the improper rakes. It is essential, if a

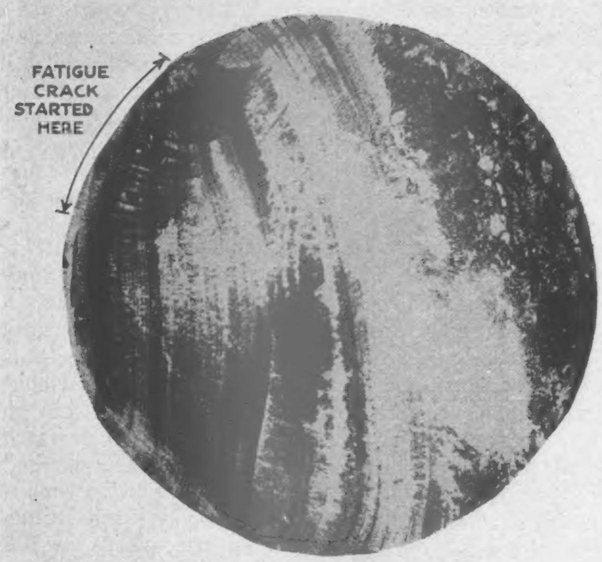


FIG. 7

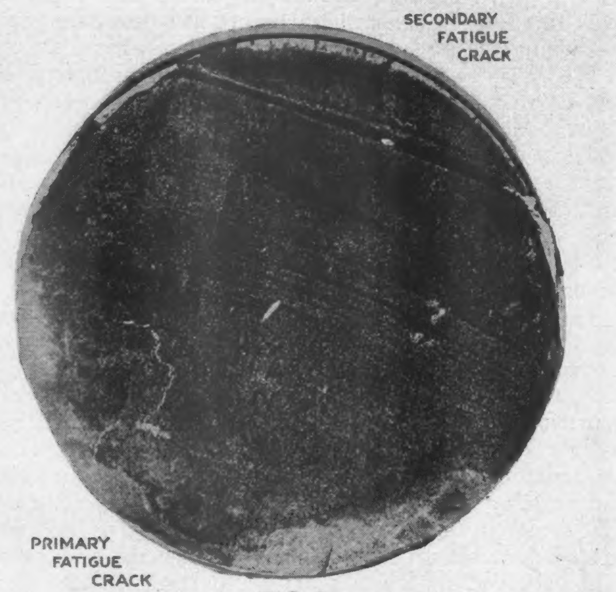


FIG. 9

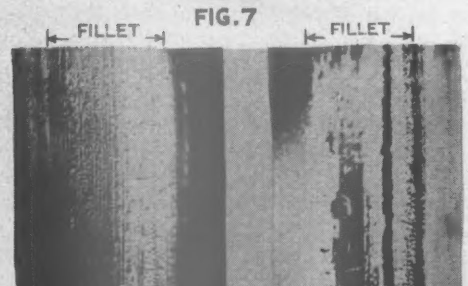


FIG. 8

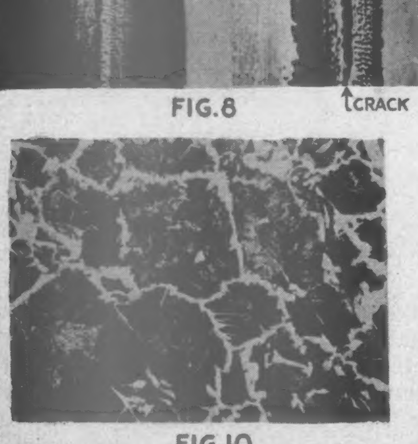


FIG. 10

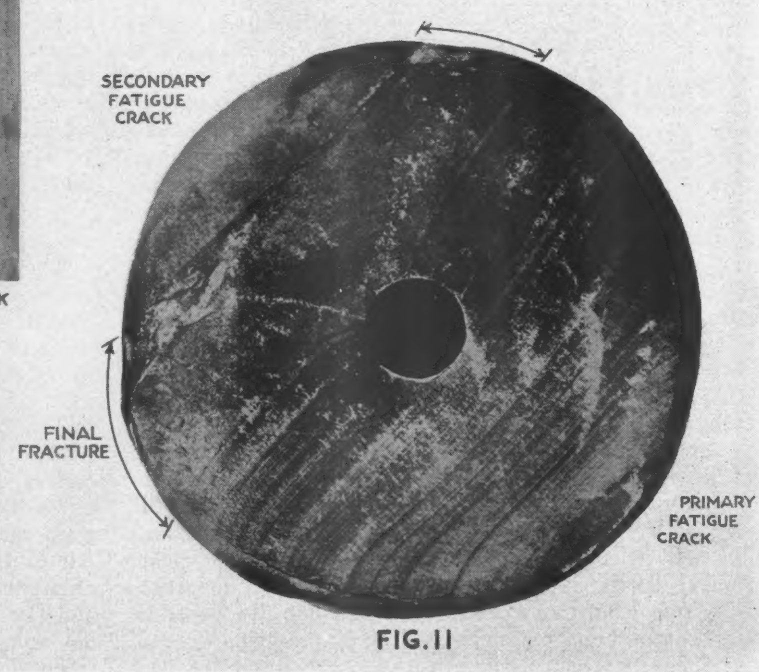


FIG. 11

Fig. 7—Broken surface of a solid crank pin. The material was apparently somewhat inferior, but poor machine finish, as shown in Fig. 8, was probably the primary cause of failure. Fig. 8—Micro-photograph showing crack and rough machining in the fillet of the crank pin, the broken surface of which is shown in Fig. 7. Fig. 9—Surface of break in this crank pin indicates rapid progress of fatigue crack. Fig. 10—Microscopic view showing coarse structure of material in crank pin, the break in which was illustrated in Fig. 9. Fig. 11—Another crank pin which failed because of roughness in the fillet

proper finish is to be obtained, that the rakes of the tool be accurately set for the material being machined.

The appearance of the break of the crank pin illustrated in Fig. 9, indicates that the progress of the fatigue crack was rapid. An examination of the structure of the steel under the microscope (Fig. 10) showed that it was very coarse, or was not properly annealed after forging. The structure of the steel was undoubtedly one cause for the very short life of the pin after the crack started, but the initial cause of the fatigue crack was the rough machining. This crank pin was placed in service November 29, 1925, and failed October 30, 1934, after nearly ten years of service, and therefore gave reasonably good service in spite of the poor heat treatment of the steel. It would undoubtedly have given its full life, that is, until worn to the limit, had it been finished properly in the fillet when it was re-turned during shop repairs. It is quite evident that it did not last long after the final turning, because of the coarse grain of the break, which indicated that the fatigue crack spread rapidly.

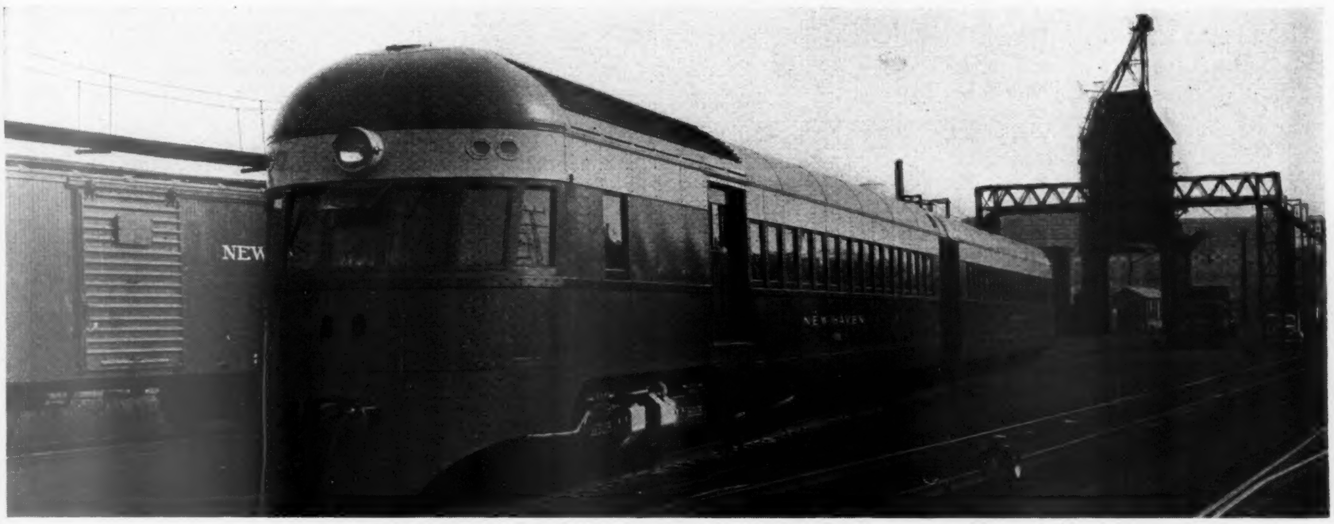
We have in this case, therefore, a pin of poor steel, which lasted for nearly ten years, finally failing because some shopman was either rushed to get the pin turned, or was careless, or because the shop in which it was finished did not consider polished fillets necessary.

The structure of the fracture of the crank pin illustrated in Fig. 11 indicates that it was properly heat treated, and also—because the fatigue cracks extended

(Continued on page 495)

Condensing Engines and Automatic Boiler Feature

New Haven Steam Rail Train*



The Besler two-car steam train on the New Haven

Two existing coaches remodeled and equipped with Besler power plant providing a flexible facility for use in local service

THE New York, New Haven & Hartford now has in service, between Bridgeport, Conn., and Hartford, a two-car steam-powered rail train equipped with the Besler steam power plant. This train is operated in almost continuous service from 6:00 a.m. to 10:20 p.m. making six trips of 31.9 miles between Bridgeport and Waterbury and one round trip of 125.86 miles between Bridgeport and Hartford each day, giving a total daily mileage of 317.26.

When it was first decided by the New Haven to use a Besler power plant the idea was to make the most economical possible application, from the standpoint of initial investment, in order to be able to demonstrate in service the capabilities and reliability of the equipment. This would involve simply the application, to two existing coaches, of the power truck, boiler, condensers and control equipment, together with the operating compartments at the ends of the train. A preliminary consideration of this idea, however, indicated that a much better job could be done by a complete rebuilding and remodeling of the two coaches at a comparatively small increase in cost.

As finally completed, loaded with fuel and water ready to run, the weight of the train is 303,600 lb. The two steel coaches which were converted into this train had a weight of 258,400 lb. The application of the Besler power plant and the modernizing of the two cars, plus fuel and water and air conditioning equipment, therefore has only added 45,200 lb. to the weight of the original equipment. With 500 hp. available at the rail the Besler train, ready to run, has a horsepower-weight ratio of 607 lb. (3.3 hp. per ton). By comparison the New Haven Comet, loaded with fuel and water ready to run, weighs 260,590 lb. This is powered with two 400-hp. Diesel engines, giving a total of 800 hp. If, however, all auxiliary equipment is in operation at once, considering the efficiency of the electric drive, a maximum of 600 hp. is available at the rail. This gives a horsepower-weight ratio of 434 lb. (4.6 hp. per ton). If, instead of applying the Besler power plant in the older steel coaches as was done in this case, such a power plant were applied to two of the modern New Haven light-weight streamline coaches, it is reasonable to expect that a two car train could be built with a total weight, ready to run, of approximately 250,000 lb. This would have a horsepower weight-ratio of 500 lb. (4 hp. per ton).

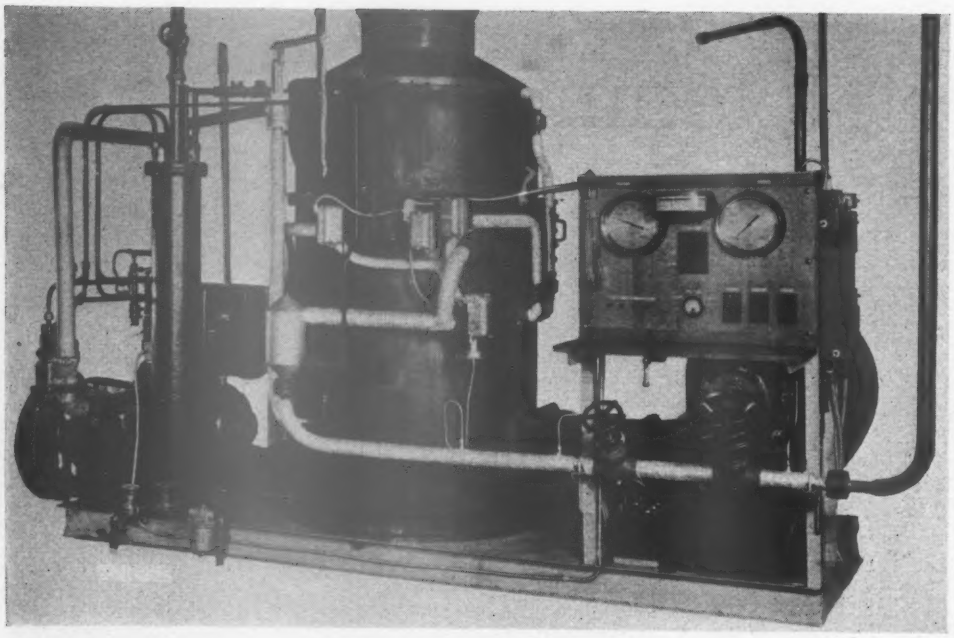
Characteristics of Besler Train and The Comet

	Besler train	The Comet
Total horsepower	600	800
Horsepower at rail	550	590 (min.)
Seating capacity	152	160
Baggage capacity	12 ft.—3,000 lb.	None
Overall length, ft. and in.	163—2½	207—0
Total weight, ready to run, lb.	306,600	260,590
Distributed weight, power truck, lb.	104,000	86,835
Trailer truck power car, lb.	67,000	43,890
Trailer, inside truck, lb.	65,000	44,375
Trailer, leading truck, lb.	67,600	85,490
Weight light train, lb.	296,100	248,590
Weight power plant and control, lb.	32,700 (approx.)	71,039

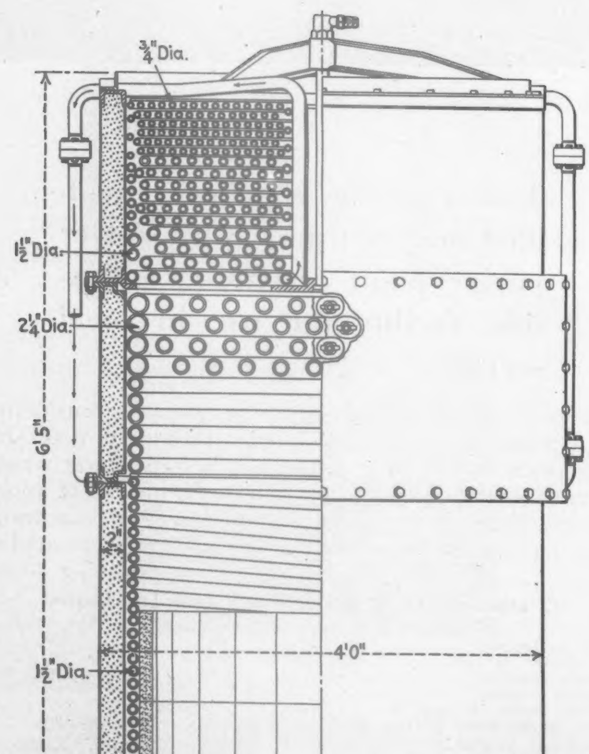
General Construction and Arrangement

Two old New Haven steel coaches, approximately 20 years old, were selected and designs worked out for remodeling them by the application of the Besler power plant and other modifications into a modern appearing streamline train. These old cars were of the monitor-room construction, with narrow letter boards. As remodeled the exterior was changed to give an outside

* This article is based on papers presented before the New York Railroad Club, October 16, 1936, by K. Cartwright, N. Y. N. H. & H. (describing the train), and Geo. D. and Wm. J. Besler (describing the power plant), supplemented by additional details concerning the boiler. There is also included a summary of questions raised during the discussion following the presentation of the two papers.



Steam generator as set up in the laboratory for testing



Half section of the Besler Uniflow boiler

appearance somewhat comparable to the road's latest streamline coaches. The cars were stripped down, lower-deck roof sheets and some details of the old deck framing removed to save weight, and new carlines and roof sheets applied from side plate to upper deck sheets to form a turtleback roof. The old narrow letter boards were replaced with wide letter boards and skirting applied below the side sill and joining in with the side sheathing. All new sashes were applied, the sashes being sealed into the car.

The interior arrangement and appearance of the car were completely changed. In the old cars saloons were placed one at each end of the car. In the new design both saloons were placed at the same end, and they were equipped with toilet and lavatory facilities, including shelves and mirrors similar to the streamline coaches. Mirrors were also applied at each end of the car. The old heavy Tucolith flooring was removed and a light-weight Tucolith floor applied over new chanarch, with an upper floor of composition rubber in a mottled gray pattern, harmonizing with the interior color scheme. This was laid in three strips running lengthwise of the car. The old seats were replaced by new walkover seats especially designed for the cars, having chromium-plated tubular frames with cushions upholstered in a blue figured plush.

The interior cross-section was radically changed, the old clerestory being supplanted by a flat headlining running across the car just below the old lower-deck carlines. Suitable framing was applied across and below the lower-deck carlines to support the new headlining. The space thus made available between the headlining and the roof in the old clerestory section was utilized for the distributing air duct for air-conditioning system. The old lamp fixtures were all removed from the deck and the center of the car and new ceiling fixtures with prismatic lenses set flush with the headlining were applied over each seat. Modern aluminum basket racks were applied in place of the old bronze racks.

The old heating system was completely removed and replaced by fin-tube radiation, thermostatically controlled and interlocked with the air-conditioning system. A center-duct air distribution was used with an electro-mechanical cooling system, operated at 110 volts and driven from a separate 25-kw. generator and auxiliary engine located in one corner of the baggage room. The capacity of the air-conditioning unit in the power car is five tons and in the trailer car seven tons.

On the power car a section 8 ft. long at one end was reserved for application of the Besler boiler plant and auxiliary equipment. Following this is a 12-ft. baggage compartment. The necessary baggage-room door openings were provided in the sides of the car, sufficient reinforcement being applied to compensate for the omission of the side posts made necessary by the wide baggage-room door. The windows in this section of the car were all removed and new sheathing applied over the window openings. The entire length of 20 ft. over

the boiler room and baggage-room on the roof is taken up by the condensers and exhaust-steam-driven fans. A number of special details of construction had to be worked out properly to carry the weight of condensers and fans and also mantain the necessary strength across the sides of the car.

One of the most difficult problems was in the streamlining of the ends. The operator's compartment had to be placed in the streamline end and a sufficient amount of strength had to be worked into an end design that could be readily incorporated into the existing structure. The vestibules were entirely removed with the exception of the existing vestibule end sills. Pressings were applied to the vestibule end sills in order to carry the section forward at that point, and a continuous angle formed at this section, tying into the side sill of the old structure. Other continuous formed angles were applied, tying into the old structure at the top and bottom of the letter board.

The bottom contour of the streamline end was formed by a continuous angle tying into the side-sill construction back of the body corner post. Vertical channel sections were applied, running from the bottom to the top between the window openings in the operator's compartment. A continuous formed outer belt rail was applied, tying in with the existing belt rail back of the body corner post. In this manner a very substantial and adequately protected operator's compartment was obtained. The necessary control apparatus was applied in each compartment and the train is operated in either direction without turning.

Trucks and Brake Equipment

The old truck under the boiler end of the power car was replaced by the Besler power truck, all other trucks remaining the same. The old PC brake was removed and replaced by HSC equipment, and two brake cylinders, 10 in. by 10 in., were used on the power truck, the old 16-in. by 12-in. cylinder on the original car being retained for braking the rear truck on the power car. One 16-in. by 12-in. cylinder is used for braking the trailer car. The old axle generators and batteries were removed from both cars, a new battery being applied to the trailer car of only sufficient capacity to provide starting for the Besler equipment. The lights are operated from the 5-kw. auxiliary generator in the boiler room, this generator being in continuous operation whenever the train is in service.

The interior of one of the coaches

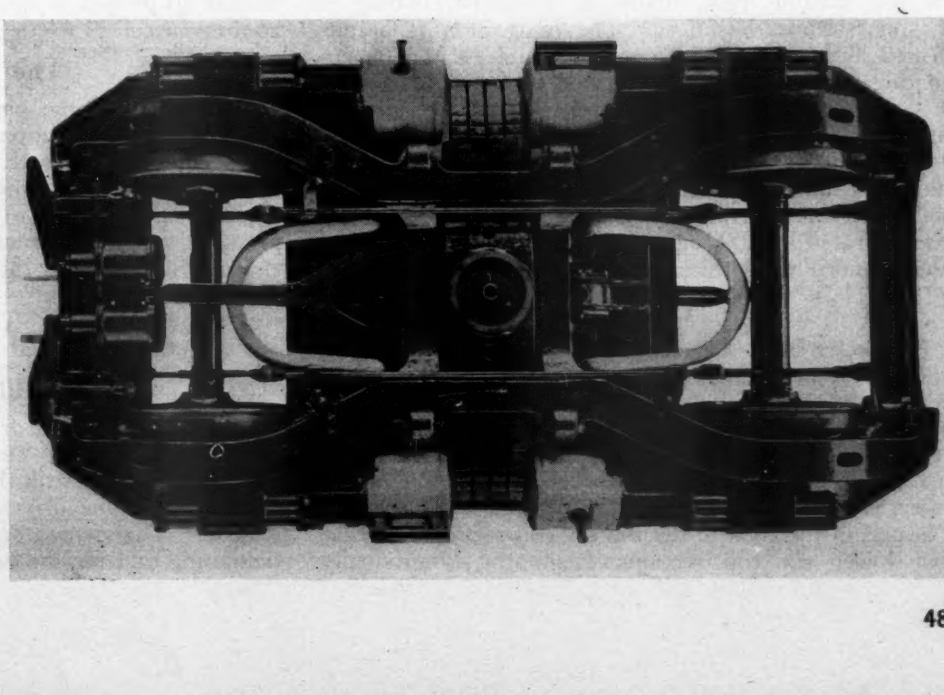
Fuel and water tanks of 500 gallons capacity each were applied to the power car. The cars were semi-permanently connected together, the old couplers and draft gears being retained. The free travel in the draft gears was taken up and some initial compression placed in both gears so that no slack action would be experienced. The uncoupling levers were removed, necessary wiring and control connections were made between the cars by jumpers which can be removed if it should ever be necessary to cut the cars apart.

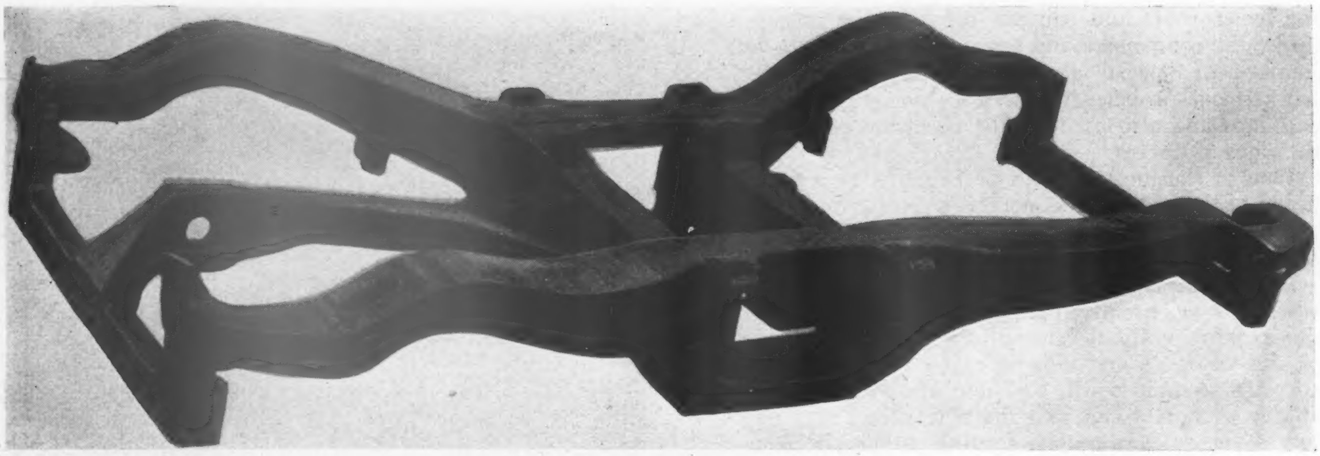
The interior of the cars was finished with the same color scheme as the road's streamline coaches, the headlining being a light cream down to the frieze board; frieze board, window panels and ends of car down to window capping, aluminum, and sides and ends below the window capping, a dark gray. A red stripe was carried around the car at the molding above and below the baggage rack. The exteriors were painted a royal blue up to the letter board, with a stripe of pimpernel scarlet the full width of the belt rail. The letter board was finished in aluminum and the roof a darker shade of blue.

The Power Truck and Engines

The overall length of the power truck is 17 ft. 8 in., and the total width over the cylinder lagging cover is

Top view of the power truck showing the truck and engine-frame castings, and the brake and spring arrangement





The cast-steel power-truck frame

9 ft. 5 in. The wheelbase is 11 ft. 6 in., and Bethlehem low-carbon molybdenum wheels with chrome vanadium axles are used. Four coil springs at the extremities support the over-riding truck frame which in turn supports the car body through a conventional swing bolster and elliptical spring plank.

Simplex clasp brakes are used, with two brake cylinders mounted on the truck. Westinghouse slack adjusters are provided, and there are two brake shoes on each wheel.

The over-riding truck frame is a large four-legged spider, and two engine yoke frames, which ride with and take their alinement from the axles, are attached to the truck frame by ball joints.

The total weight of the power truck is 35,000 lb.

There are two direct, two-cylinder compound engines, each having cranks pressed onto extensions of the axle stub outside of the journal bearings. The high-pressure cylinder is 6½ in. in diameter and the low-pressure cylinder is 11 in. in diameter. Both cylinders have 9 in. stroke. These are conventional double-acting compound engines, with piston valves. The crossheads are cylindrical in shape and are made of cast steel with babbitted shoes. All bearings are of the roller type throughout and all working parts are machined all over.

The valve mechanism is a Stephenson link motion arranged to be operated pneumatically to give two positions forward and two positions reversed. All piston and valve rods are of Nitralloy and the wrist pins are of the full floating type, made of Nitralloy running in phosphor-bronze bushings. The lubrication is accomplished by splash within a sealed crankcase, and a circulating plunger pump is furnished to assure lubrication at slow speeds. The cylinder relief valves are air operated.

The engine is designed for a steam pressure of 1,500 lb. per sq. in. and, at 1,200 lb. inlet pressure, the truck has an average starting tractive force of 15,000 lb. The truck is rated at 1,000 hp., although it is capable of producing more than this with sufficient boiler capacity.

The Boiler

The boiler is of the continuous-flow, non-water level type, having no drums or headers. The general arrangement of the coils in the boiler is shown in an accompanying drawing. The tubes in the coils vary in diameter from ¾ in. in the top rows to 2¼ in. diameter in the superheater section. The water enters the top of the boiler, passing down through the pancake coils where it is heated in the coils in the top six coil sections. In the next lower six coil sections the water is gradually changed to steam. Having reached a point in the boiler directly above the superheater coils, the saturated steam passes through a tube, indicated by the arrows in the drawing, to the outside of the boiler through which it is taken to the top of the coil group which entirely surrounds the side walls and bottom of the combustion chamber. The steam in working its way through these coils passes down alternate rows to the bottom coil underneath the combustion chamber. Having completed a circuit in the bottom coil, it passes up other alternate rows of tubes to a point at the top of the combustion chamber where it enters the bottom of a seven-tube coil immediately under the superheater section. After passing through this section it goes into the superheater section composed of five rows of header type coils. The superheater coils are U-shaped in arrangement with the return bends at one end and a cross-header between coil units at the opposite end at which clean-out hand-hole plates are fitted to the boiler shell. The formation of scale in this type boiler is confined to the superheater section and the clean-out hand-holes are provided to facilitate the use of a mechanical cleaner in the superheater tubes. The entire boiler is encased in an airtight sheet-steel housing with 2 in. of insulation between the inner and outer casings. The inner casing is constructed of corrosion-resisting Inconel and the outer casing, separated from the inner casing by insulating brick, is made of sheet iron.

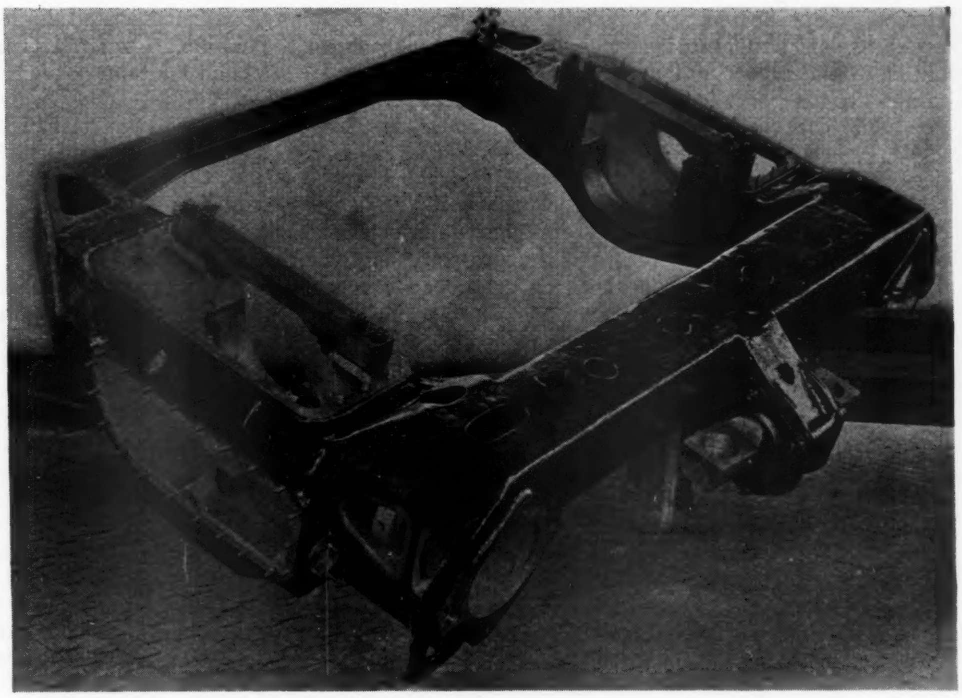
The boiler is equipped with fully automatic safety devices to protect it against empty water tanks or other contingencies.

The Oil Burner

The burner is the pressure atomizing type of Besler design and construction. It automatically meters the fuel in proportion to the flow of air which is delivered by a multivane type blower. Adjustment is not necessary because of a change of altitude or a change in draft pressure, and the burner automatically compensates for changes in air flow caused by entering tunnels, high speeds, or cross winds—in every case metering the correct amount of fuel. The burner operates fully on or off. Ignition is secured by a high-tension electric spark.

Auxiliary Engine

The auxiliaries are driven by a two-cylinder, 90-deg. V-type double-acting steam engine. The water pump drives are integral wtih the main crank shaft. The auxiliary steam engine drives the electric generator through V-belts. The generator supplies current for lighting, ventilating and for the requirements of the power plant.



Cast-steel engine frame showing the bolting locations for the cylinders and crank-case cover plate, and the ball-joint connection to the truck frame—Two of these castings are used in each truck

The auxiliary engine also drives the air compressor and the forced-feed main-engine lubricators. It operates at a back pressure and exhausts into the train-heating line. When train-heating is employed the power used to drive the auxiliaries represents only two per cent of the boiler output.

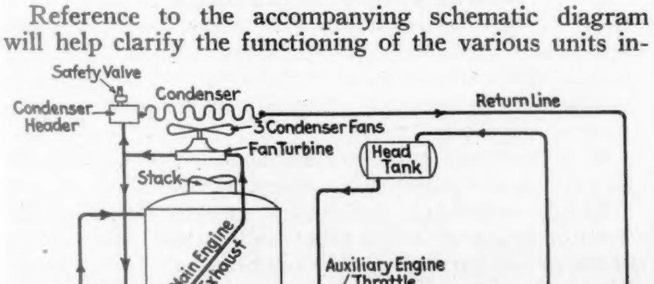
The Condenser

The condensers are of the fin and tube type, placed on the roof of the car. Propeller type fans driven by individual exhaust-steam turbines of our own design and manufacture are located adjacent to the condenser cores on the roof and draw air through the cores, discharging it upward.

The turbine speed inherently varies in proportion to the steam flow, producing the optimum relation between air flow and condenser load at all outputs.

General Scheme of Operation

Reference to the accompanying schematic diagram will help clarify the functioning of the various units in-



Schematic diagram showing the relation and functioning of various parts of the equipment

volved in the power plant and auxiliary. Water from the main storage tank is pumped by a motor-driven lift pump to a header tank, thence to the boiler feedwater pump which is one of the three auxiliary units driven by a high-pressure auxiliary engine. From the feedwater pump the water passes through the feedwater heater, thence to the boiler. Its course through the boiler has been previously described. Superheated steam at constant temperature and at a maximum pressure of 1,500 lb. per sq. in. leaves the main steam outlet of the boiler. Superheated steam is used in the main engines on the power truck and in the auxiliary engine. The main engine exhaust is piped to the three condenser fan turbines. The auxiliary engine exhaust is piped to the feedwater heater. Exhaust steam after passing through the feedwater heater and the fan turbines goes to the condenser header which is equipped with a safety valve as a protection against excess pressure in the condenser coils. The condensate from the condenser passes through a return line to the water storage tank.

Questions and Answers Concerning Operation

At the New York Railroad Club meeting at which the description of this train was presented many questions were asked concerning this equipment. The answers to a number of these questions as given by W. J. Besler, are included herewith.

1. Q.—*What is the percentage of makeup water in the summer time when steam is not used for heating?* A.—It is approximately the same as in the winter when water is lost through heating. In the winter time, there is no return from the heating pipes, so that the water is wasted. No records of the amount of water consumed by the power plant are available at present.

2. Q.—*How is scale formation prevented in the boiler?* A.—Scale is not prevented. Scale forms only in a certain portion of the boiler which is provided with clean-out openings. Cleaning is accomplished either by dissolving it, or by the use of a turbine cleaner after removing the clean-out plugs, which is a simple operation. Any other means of feedwater treatment may be used to keep down the scale deposits.

3. Q.—*Is the steam superheated?* A.—Yes, the

steam is superheated. At 500 lb. pressure or 800 lb. pressure, the temperature is maintained constant at the outlet of the boiler and runs 760 degrees. It is maintained at that point to give a good overall efficiency and good lubrication.

4. Q.—*How does oil treat the feedwater?* A.—Oil goes into the feedwater because the engines are lubricated by spraying oil into the engine cylinders. The oil is carried to the condensers and from there it is returned to the feedwater tank. This oily feedwater is pumped to the boiler, which is one of its features. In a steam automobile boiler, which is now 27 years old, the boiler has never been touched. The tubes are perfectly clean because of the presence of a large percentage of oil. Upon analysis this was found to be some four or five percent of the feed water.

5. Q.—*Is straight mineral oil or compounded oil used?* A.—Both types of oil are used.

6. Q.—*Does the atomizing burner run intermittently or at varying speeds, so as to develop steam in proportion to the speed requirements of the train?* A.—The atomizing burner is of the on-and-off type.

7. Q.—*How is feedwater regulated?* A.—There is a control mechanism which supplies water whenever the pressure is sufficiently low and whenever the temperature is right. The injection of water is proportioned according to the temperature within the boiler. It is fully automatic in operation.

8. Q.—*What kind of fuel is used?* A.—So far, any type of fuel has been used with which we have come in contact. On this train the lighter grade of fuel is preferred, as the cost is not yet prohibitory. Any of the oils produced in America can be burned, as they have been tried in the laboratory.

9. Q.—*What is the combustion rate in the boiler?* A.—Over 500,000 B.t.u.'s per cu. ft. per hr., although a maximum of over 2,000,000 B.t.u.'s per cu. ft. per hr. have been released.

10. Q.—*What is the stack temperature?* A.—500 deg. F.

11. Q.—*What is the water rate of the engine at various speeds?* A.—10 lb. over a wide range of speeds and loads. That water rate can be maintained from 1200 lb. inlet pressure down to 400 lb. inlet pressure, which is the operating range at the present time.

12. Q.—*How frequently must scale be removed from this type of boiler?* A.—The present indications are that it should be removed each 30 days, although on the New Haven train, it was operated the first six weeks without removing scale.

13. Q.—*What is the weight of the boiler?* A.—5,100 lb. complete.

14. Q.—*What effect will snow have on the condenser exhaust fan?* A.—When snow comes in contact with the fans two things may happen to dispose of it. Either the fans will throw it out of the way or the heat will melt it.

15. Q.—*What is the temperature of the boiler room?* A.—Temperatures as high as 140 deg. have been recorded in the boiler room, although at that time no one was in the room.

16. Q.—*Are conventional snap rings used on the pistons of the engines?* A.—Yes.

17. Q.—*How many rings are used on each piston?* A.—Six.

18. Q.—*What is the maximum speed of this train, and at what speed is maximum horsepower developed?* A.—The horsepower is constant from 12½ to approximately 65 miles per hour. The train is guaranteed to do 70 miles per hour, although on one run a maximum of 82 miles per hour was reached. Operating conditions necessitated limiting the speed, so that it is not possible to say how much more speed it might be possible to attain.

19. Q.—*Is a fireman used on this train?* A.—Yes, when the train is backing up, that is, being operated by means of the controls at the opposite end from the power unit, the fireman rides with the engineman, 160 ft. away from the boiler.

20. Q.—*How much power is required for the condenser exhaust fans?* A.—The condenser fans require approximately 30 hp. under a full load. That is available at a loss to the engine which is not very great, as 12 lb. back pressure on the engines does not amount to much horsepower. Turbines are used for driving the fans.

21. Q.—*With moderate volume production, what proportion of the total cost of the train is in the power plant?* A.—On the New Haven train, approximately one-fourth of the cost is represented by the power plant and three-fourths for the train.

22. Q.—*Approximately how long would it take to remove the power truck and install a reserve truck in case of necessity?* A.—If a reserve power truck were available, it would merely be a problem of lifting the car, rolling the new truck in, dropping the car and making the various steam and air connections.

23. Q.—*Is the boiler operated at constant pressure?* A.—No attempt is made to maintain constant pressure. The boiler operates at a constant superheating outlet temperature. A constant temperature is maintained, as that is what determines proper lubrication and efficiency.

24. Q.—*Is the lubricating oil atomized into the cylinders or fed onto the cylinder walls?* A.—It is fed into the valve chamber and atomized by the velocity of the steam.

25. Q.—*What is the fuel consumption per hour?* A.—One lb. of fuel per hp. hr.

26. Q.—*When the train is operated by means of the controls at the opposite end from the power unit, what controls and what gages does the operator have for feedwater for the boiler?* A.—The controls consist of a throttle, air-brake valve and reverse mechanism. There is nothing to indicate to the operator what is going on at the power plant, as the operation of the boiler is entirely automatic.

27. Q.—*What type of a transmission is used?* A.—There is no transmission. The steam engine connecting rods are directly connected to cranks which are pressed on to an extension of the axles. It is interesting to note that there is not a single gear of any description on these two cars.

28. Q.—*How is the control operated from the opposite end of the train?* A.—Pneumatically.

29. Q.—*What is the storage capacity of the boiler?* A.—Only enough to go about half a mile. Storage capacity is not carried in the boiler water, but in the hot tubes. As the pressure drops an additional quantity of water comes from the economizer section of the boiler, and in contacting the hot tubing it generates steam which gives this boiler its amazing reserve capacity.

30. Q.—*How long does it take to get the boiler hot from cold water?* A.—The rail car is able to get steam up in an average time of five minutes from dead cold. It cannot be operated in five minutes, however, because of the necessity of pumping up air for about 12 minutes. The time required from stone cold to the point where it is ready for operation depends upon the time required to pump up air. As far as the boiler is concerned, working steam pressure can be built up in approximately 3¼ to 4 min. from the time the fire is started.

Causes of Failures of

RAILROAD SPRINGS

By R. W. Clyne*

THE replacement cost of a broken spring is not the only economic factor resultant from the fracture; in fact, the principal loss in dollars may generally be attributed to the service loss of the equipment during the repair period. The value of the spring itself is also generally small when compared to the interchange charge or the labor and overhead costs arising in the yard during the servicing of a car or locomotive. These various charges, direct and indirect, arise of course, from the original spring failure and may frequently be eliminated by a more comprehensive understanding of the fundamental causes of failure. Spring manufacturers as well as railroad engineers must become aware of the factors influencing the service behavior of springs, for the problem of reduction in the charges resulting from failure is a mutual one.

Solution of the problem is largely technical and involves the practical application of the latest advances in metallurgy, physical testing and design, as well as appreciation of the fact that *the cheapest spring* is usually the *most expensive one.*

In view of the fact that maximum stresses in railroad helical carbon steel springs are frequently as high as 150,00 lb. per sq. in. and that maximum stresses in alloy elliptics of 160,000 lb. per sq. in. are not uncommon, it is not difficult to realize that the potential sources of failure are numerous and may originate in the rolling mill or in the original design, or during manufacture or in service. Due to the singularly high stresses which mechanical springs sustain during service, premature failures may be encountered if metallurgical or physical testing principles are ignored during any process of manufacture or during service. This expectation is not lessened by the present trend towards higher railroad speeds, lower spring weights, alloy steel and high spring stresses.

Overheating of the steel during manufacture is one of the chief causes of reduced resistance of springs to service conditions. Occasionally, overheating takes the form of actual burning of the steel and when this occurs it is usually due to carelessness and poor workmanship during the heating operation prior to tapering. Another form more frequently assumed by overheating is the formation of a maze of surface blisters and general deep surface roughness due to extreme oxidation—usually caused by the employment of very high furnace temperatures prior to coiling, in an effort to coil large bars rapidly. This condition is generally found in bars of 1-5/8 in. diameter steel and larger when a manufacturer does not have a coiling machine of sufficient strength to successfully handle bars of these sizes when heated to the proper temperature. While reheating and quenching of these bars will usually produce the desired microstructure, the original rough and pitted surface is retained, and as a result the fatigue strength and service life of the finished spring is materially reduced.

Burning and extreme surface roughening are reflections of poor operations control and improper equipment, and should not be encountered in modern spring production. There is a final aspect of overheating, however, the continuation of which is almost entirely due to economic pressure on the part of purchasers, and to which may undoubtedly be ascribed a large proportion of carbon steel spring failures. The quenching of carbon springs direct from the shaping operation (single heat treatment) is generally a practice which should be abandoned, for if the steel is heated to a temperature sufficiently high to compensate for heat losses at the bar ends and plate edges during shaping, the micro-structure has been so coarsened that the finished spring is unfit for severe service and is susceptible to early failure. This excess grain growth and wide variation in hardness and hardness penetration result in lowered impact resistance, lowered fatigue resistance, and wide scatter in resistance of the springs to service conditions. In addition, springs of such coarse micro-structure are probably susceptible to permanent set in service, for another effect of the overheating and irregular cooling prior to the quench is the building up of severe and highly variable internal stresses upon quenching, which cause marked contraction of the usable elastic range of the steel. Permanent set and permanent injury of the steel may be the result of this action.

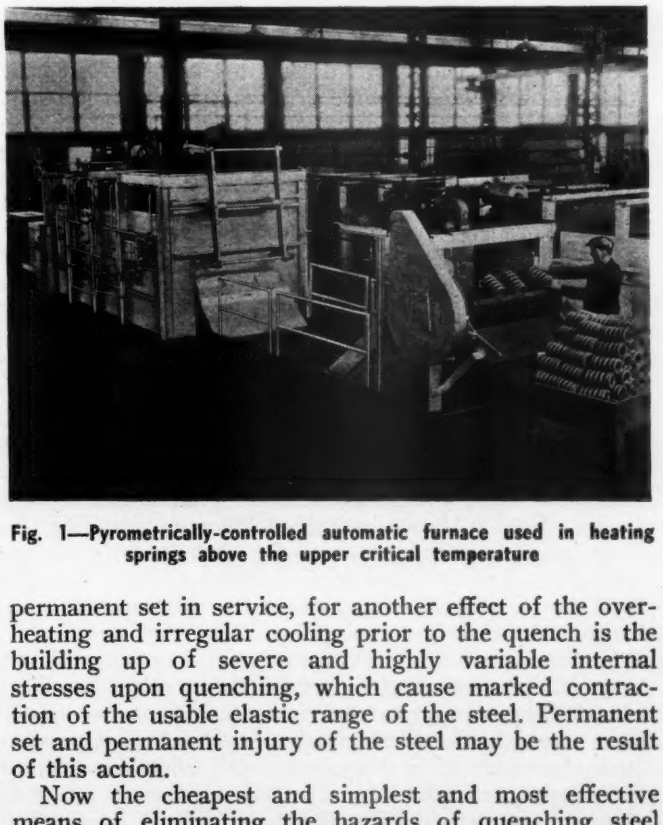


Fig. 1—Pyrometrically-controlled automatic furnace used in heating springs above the upper critical temperature

Now the cheapest and simplest and most effective means of eliminating the hazards of quenching steel springs direct from the shaping operation is to employ the so-called "double heat treatment" method.

In this process, as practiced by the American Steel Foundries, the coiled springs are air cooled to a black color, are then reheated to slightly above the upper critical temperature, in pyrometrically controlled automatic furnaces of the type shown in Fig. 1, and are then oil quenched. Thus, the temperatures necessary for rapid and precise coiling may be used without adverse effects

* Sales engineer, American Steel Foundries, Chicago.

for the desired micro-structure is formed during the second heating and is retained upon quenching and drawing. This micro-structure is almost completely independent of the temperature of coiling.

The resultant spring is metallurgically correct (through the heating and quenching operations) and this condition is reflected in longer service life and increased resistance to permanent set and repeated loadings.

Upon removal from the quenching medium the springs are exposed to the drawing temperature in order to reduce and equalize internal stresses and hardness and increase the elastic range. Time-temperature relationships are of extreme importance during this operation if equalization is to take place without severe reduction in tensile strength and elastic and fatigue ranges. The advantages of alloy steels are materially curtailed if high tempering temperatures are employed and the steel is so softened that the resultant physical properties are greatly reduced. Short exposure to high temperatures (as in flash drawing) has little effect on internal stresses and produces sharp reduction in tensile and torsional properties of the surface layers. The net effect of this treatment is the establishment of an unbalanced condition throughout the spring. Maximum strength and resistance is applied dynamic loads is a function of both time and temperature during the drawing operation and it is essential that the proper relationships be applied to standard shop practice. The principal drawing furnace used by the American Steel Foundries at their Hammond, Indiana spring works is shown in Fig. 2. This automatic furnace is designed for the treatment of both helical and elliptic springs. It is of the three zone continuous apron conveyor type, gas fired, and temperatures are maintained by potentiometer recording controllers.

Fig. 2—A.S.F automatic drawing furnace designed for the treatment of both helical and elliptic springs

Stress-corrosion and decarburization are probably the two greatest sources of reduced spring strength and service failure. Our researches indicate an increase in fatigue strength of approximately 65 per cent if the decarburized surface of heat treated elliptic plates is removed by grinding. Apparently, the decarburization effect is greater than any possible effects which may be ascribed to alloys or heat treatment. The combination of effects produced by controlled gas mixture and scaling in a continuous heat treating furnace of the type shown in Fig. 3 is such that free ferrite is practically eliminated. This condition should contribute towards increased service strength by reduction in the zone of weakness. While it is possible to control the carbon-free volume in spring steel, no practical and completely effective solution has yet been proposed to the problem of complete control of all surface layer carbon during the various heating operations to which spring steel is subjected. The solution will require the cooperative research of the steel mills and spring manufacturers. The concession to decarburization is too large to be allowed to continue indefinitely, and extensive and joint research must begin in the very near future. Stress-corrosion occurs in all service in which dynamic stress and corrosion proceed simultaneously. The American Steel Foundries has promoted active research in this field also and has developed an inexpensive protective surfacing which should materially increase the life of railroad helical springs which are exposed to severe corrosion conditions, such as occurs in refrigerator car service. Our researches on stress-corrosion show that 300,000 cycles is the average laboratory life of helical springs when exposed to 3 per cent salt solution and a stress range of zero to 44,000 lb. per sq. in. This early failure is due to the rapid formation of sharp and deep stress corrosion pits and cracks of the type shown at 100 diameters in Fig. 4[1].

In the absence of corrosion, however, and under the same stress range, helical springs failed to break in laboratory tests after 2,000,000 loading cycles, at which time the test was discontinued. While it seems that steps can be taken to check the effects of stress-corrosion on helical springs, there appears to be little that can be done economically to afford similar protection to elliptic springs; however, the situation is not as serious as might be concluded from the laboratory tests, for the service life of the majority of railroad springs is long and satisfactory, despite the continual exposure to corrosion. Apparently, the average service stress range is only a fractional part of 44,000 lb. per sq. in. or some strongly protective oxide coating is formed during service. Nevertheless, it is undoubtedly a fact that, in some types of service many of the spring failures are due to stress corrosion. Where, in this type of service, perishable products are in transit and losses may be sustained during shipment delays due to spring failures, all possible

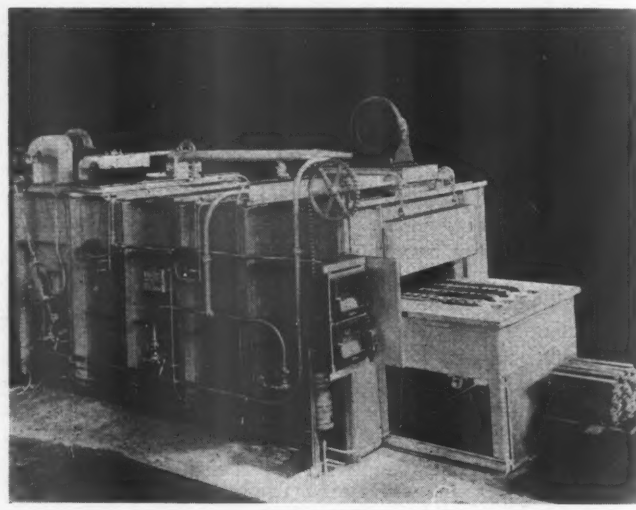


Fig. 3—Continuous heat treating furnace in which the proper control of gas mixture and scaling practically eliminates free ferrite

[1] "Influence of Chemically and Mechanically Formed Notches on Fatigue of Metals" by Dunlap J. McAdam, Jr., and R. W. Clyne, Journal of Research of the National Bureau of Standards, Volume 13, No. 4, October, 1934. This paper considers, among other things: (1) the importance of stress concentration due to notches as the cause of service failures. (2) The effect of chemically formed notches and the relationship between tensile strength and percentage decrease in fatigue limit of steels and aluminum alloys which have been exposed to the influence of pitting caused by stressless corrosion. (3) The determination of whether composite curves of similar form may be obtained from study of experimental data obtained by a number of investigations of mechanically formed notches. (4) The relationship between notch sensitivity (as measured by percentage damage to fatigue limit) and other properties of metals, such as hysteresis, ductility and work hardening capacity. (5) The influence of notches in diminishing the advantage of superior strength.

steps should be taken to eliminate stress-corrosion. Our tests indicate that the common paints afford no protection, and that metal deposits are expensive and generally inefficient. The problem is entirely different from that of static corrosion.

The effect of surface discontinuities as stress raisers or sources of stress concentration is well known. Spring steel, as received from the mill, should be carefully inspected, principally for rolling grooves, seams and laps for these discontinuities may frequently be the source of fatigue failure in the spring under repeated service loadings. It is generally quite difficult to identify these mill defects in the bars as received due to the presence of the mill scale. It is advisable to inspect pickled coupons of carbon steel. Silico-manganese steel, which is particularly susceptible to the formation of rolling seams, should be purchased in the pickled condition in order to facilitate surface inspection, and absorbed hydrogen may be ignored due to the subsequent heating operations. Occasionally it is necessary to resort to compressive tests of small sections in order to expose incipient surface defects in mill spring steel which is to be used for certain types of service. Magnetic methods of inspection for surface cracks in spring steel are receiving considerable attention at the present time and may become a part of standard shop practice in the near future.

An additional source of spring failure is frequently found in design. The design may be incorrect with respect to the spring itself or to the space allotted to the spring in the structure of the car or locomotive, or the design may be at fault because it calls for the wrong type of spring for the service to be encountered.

In the case of coil springs, design failures may frequently be traced to misunderstanding or ignorance of

Fig. 4—Deep stress corrosion pits and cracks magnified to 100 diameters

the effect of bar curvature in sharply coiled springs. For example, a coil spring with a ratio of mean coil diameter to bar diameter of four may be designed with an apparently safe nominal maximum stress of 90,000 lb. per sq. in.; actually, however, this nominal stress is increased 40 per cent due to the effect of sharp curvature and this stress condition may produce early failure in some types of service. Recognition of the effect of curvature and application of the principles established by Wahl, Adams and Roever to routine helical spring design will, of course, eliminate this possible source of failure.

Structural failures have been traced, in some cases, to spring designs which allowed for frequent and complete closure with resultant adverse impact loadings. Springs which work under these conditions rapidly acquire permanent set and the repeated stressing in the plastic range materially reduces the fatigue resistance of the steel. The probable effect of the repeated overstress is the formation of incipient surface cracks. Subsequent heat treatment will not remedy this condition. Accordingly, the reworking of springs which have acquired severe permanent set in service is a practice of doubtful economy.

Eccentricity in loading, caused by the bearing coils in helical springs, increases nominal stresses. The stress increase is subject to analysis and the proper factors have been incorporated in the American Steel Foundries' design tables, as have the factors for the effect of bar curvature. The stress factor due to eccentricity varies with the ratio of solid height to bear diameter and the stress increase is greatest in short springs and should be given particular attention in the design of such springs. Elliptic spring fractures which may be traced to the original design are usually found to be due to a stress condition which is frequently the result of failure to consider the effect of sectional concavity or of plate ends or of plate offset or of too many full length plates. The effect of friction in increasing stress has generally been ignored. Static friction and its effect upon the transmission of forces must be considered in spring riggings as well as flexibility of the springs at the ends of the rigging. Occasionally, elliptic plate failures arising from the "shop" design are due to too little "tuck"[2] in the back plate, causing high mean stresses under the service range, or too much "tuck" in the short plates, causing the same adverse condition in these members.

Now the precautions adopted by the American Steel Foundries to insure reduction in the possible sources of railroad spring failures are numerous and very effective. These precautions are almost entirely based on extensive research and have taken the very practical forms of: Continuous heat treating furnaces, automatic coiling equipment, direct reading Brinell hardness testing machines, heat exchangers for automatic temperature control of quenching oil, high speed large specimen fatigue machinery, investigation of decarburization and stress-corrosion, specialized inspection methods for rolling mill defects, and the development of spring tables and working diagrams which consider the effects on stress of curvature, loading eccentricity, dead coils, friction, plate ends, plate offset, etc.

Disc-Flo Journal Bearing Unit for High-Speed Service

A new type of journal-bearing unit, known as the "Disc-Flo," has been developed by the research laboratories of the National Bearing Metals Corporation, St. Louis, Mo. This unit, free-oil lubricated without waste packing, is designed to operate with safety and economy in high-speed passenger service under all weather conditions, having been tested in the laboratory at continuous speeds up to 200 m.p.h. with full load and temperatures as low as 40 deg. F. below zero.

Two cars equipped with Disc-Flo units, placed in regular revenue service the middle of last June, have each made about 25,000 miles, it is said, with very satisfactory results. One of the illustrations shows a six-wheel car truck, equipped with Disc-Flo units, and another illustration gives a side view.

The principal design features of the Disc-Flo unit,

[2] Tuck may be described as the space existing between the plates of an elliptic spring at their center when the spring is assembled, but not banded, and this space is due to intentional differences in camber or radius of curvature of individual plates comprising the spring.

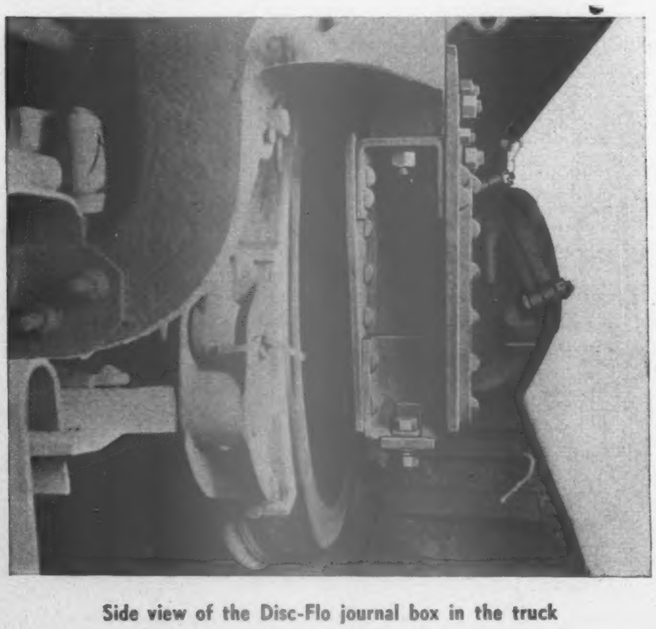
as shown in the cross-section drawing, are as follows:

The journal box is made of cast steel. A manganese-steel insert in the top of the box provides a long-life bearing surface for the equalizer and a ground concave fit for the self-aligning steel wedge.

The journal bearing is made of bronze with babbitt lining. It is provided with a flat back to eliminate any tilting which might be caused by coupling shock, starting or braking forces. The bearing has 180 deg. arc of journal coverage, which increases the thrust capacity 50 per cent. The system of oil circulation in the bearing is so shaped that it forms a wedge between the bearing lining and the journal, permitting a ready flow of lubrication under the crown of the bearing with rotation in either direction. A reservoir is also provided to collect any foreign matter in the circulating oil, keeping it from getting in between the surface of the bearing and the journal.

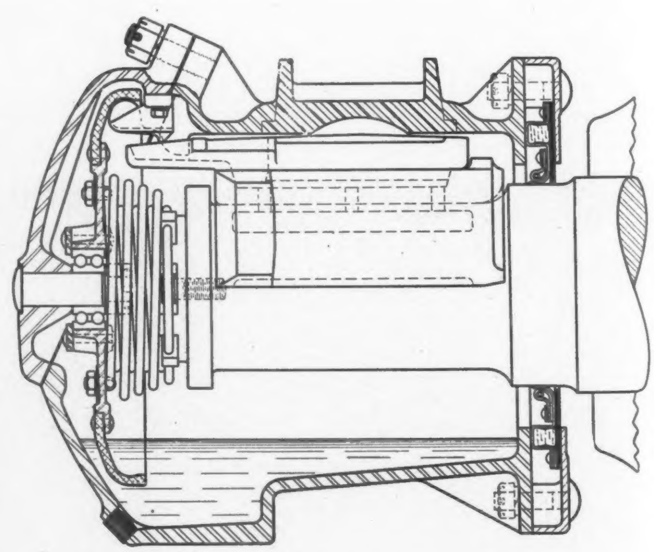
The Disc-Flo journal box

The lubricant is supplied to the bearing by means of a disc which rotates on a roller bearing attached to the inside of the journal-box cover. This picks up the oil and conveys it to the top of the box, where it is wiped off by a metal spoon; the oil then flows through the wedge and bearing to the journal. Oil in excess of that required for bearing lubrication overflows the wedge over the outside of the bearing back to the bottom of the box. The disc is propelled by a nest of two steel torsion springs of opposite pitch, firmly anchored in the disc and both attached to a male cross bar on the free end, which engages a female driving plate securely attached to the butt end of the axle by means of two cap screws. The pressure exerted by the steel torsion springs insures a positive driving connection between the cross bar and the driving plate. The entire oil-circulating mechanism is mounted on the box lid, making for simple application and removal; the operation of the lubricating mechanism is in no way affected by either bearing or journal wear or movement of the journal. A 5-in. by 9-in. Disc-Flo unit requires five pints of car oil. At 75 m.p.h. approximately 2¾ pints (80 cu. in.) of oil per minute are used for lubrication, which is less than one-twentieth of the total amount of oil circulated by the disc. Cooler operation is obtained, because the oil is used both as a radiating medium and a lubricant. The lubricating system provides immediate initial lubrication with one-half wheel revolution, and the amount of lubricant circulated increases directly with speed. The oil, analyzed after 25,000 miles of service, was said to be in excellent condition, no emulsification having taken place.



Side view of the Disc-Flo journal box in the truck

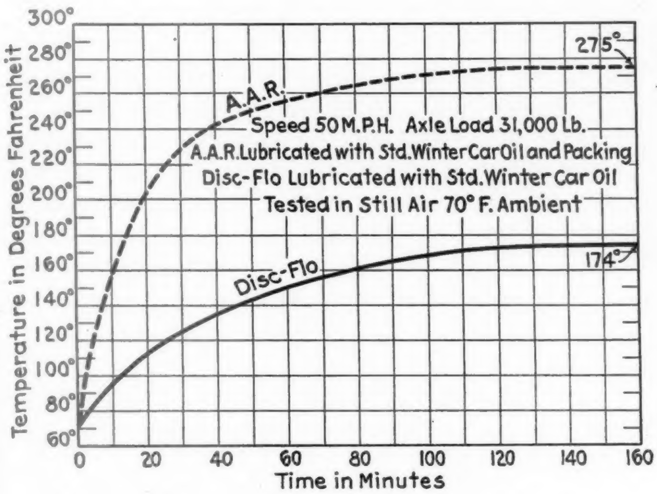
A simple and effective oil seal is held against the surface-ground back on the journal box by a seal cover secured with bolts. This cover compresses the resilient oil resisting ring gasket encased in a special treated washer, the inner edge of which fits around the journal. To keep this seal tight around the journal, a garter spring is secured to bear on it all around the axle, and is arranged so that wearing parts are lubricated from excess oil flowing off the journal. All of these seal parts are mounted on a seal plate. The seal unit is so designed that it will not rotate with the axle, yet permits the necessary vertical movement when the journal box is jacked up for bearing removal.



Cross-section showing details of new journal-bearing unit

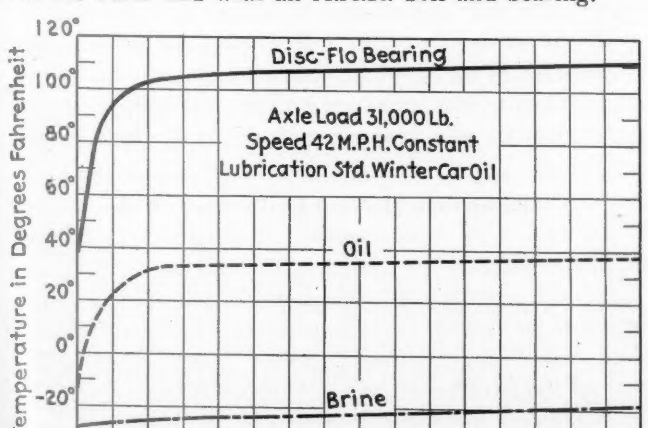
A vent is provided to equalize pressures and to prevent moisture accumulating inside of the box from condensation. A combination oil-filling and inspection cup with a spring lid is used, requiring only a few seconds to gage the oil, which is the only inspection required on Disc-Flo units. It has not been found necessary to add any oil to the original supply of five pints per box on the units now in service for over 25,000 miles.

The pedestal ways on the sides of the journal box are fitted with renewable hardened spring-steel liners. Disc-Flo units are designed to fit present standard axles and pedestals without any changes, and no special tools are required for their application, removal or maintenance.



Comparative temperatures of Disc-Flo unit and A.A.R. bearing

Operating characteristics, as determined from tests under identical loads and summer weather conditions, are said to indicate lower temperatures for the Disc-Flo unit than for the A.A.R. journal box, a reduction in temperature of 20 per cent at low speeds and 35 per cent at high speeds being obtained. These temperature tests were conducted in the laboratory in still air, so, while comparative, they are higher temperatures in both cases than would be secured in actual service. One of the charts shows temperatures of the Disc-Flo and standard A.A.R. journal bearing, these tests being made simultaneously in a Loadometer testing machine, having one end of the axle equipped with the Disc-Flo unit and the other end with an A.A.R. box and bearing.



Cold test of the Disc-Flo unit at 30 deg. F. below zero

By refrigerating the journal boxes, winter temperatures of minus 30 deg. F. were simulated to make a study of Disc-Flo units, using standard car oils. With minus 30 deg. F. box temperature, oil was said to reach a running temperature of plus 37½ deg. F., and the bearing, plus 112 deg. F., with 15,500 lb. load per bearing at 42 m.p.h. on a 5-in. by 9-in. journal. The second chart shows the sub-zero test curve.

Preliminary journal friction tests indicate that Disc-Flo units will have lower friction losses than conventional A.A.R. journal bearings.

Failures of Locomotive Parts

(Continued from page 484)

nearly across the full section before final failure—that the steel was of excellent quality. The life of the pin, however, was extremely short. It was applied January, 1933, and failed April, 1935. It had a life, therefore, of only a little over two years and failed because of the rough turned and scored fillet. It is difficult or impossible to determine whether the score marks were the direct result of the turning of the fillet, but it seemed that the fillet was scored in finishing rather than in service, since evidence of the rough turning was apparent on the torn surface.

From a consideration of these failures of crank pins, it would seem that with a proper finish of the wheel fit and fillets, the life of many crank pins can be greatly prolonged. The use of a rather coarse feed with a properly ground tool, will give a good finish. A study of proper cutting angles for the tools and the use of proper feeds, would appear to promise excellent and profitable results. Are many failures which are attributed to overload, poor design, etc., not possibly due to poorly machined fillets and to pressed fits, or to corrosion cracks where the metal is subject to reverse stresses? The officer of a large plant told me that a certain part that failed had a ground finish and that the failure could not possibly have been due to tool marks. Examination showed that the work was ground up to the fillet; then because of difficulty in grinding the fillet, it was left untouched and showed plainly the marks of the cutting tools. It is not surprising that the shaft broke in the fillet.

Conclusion

In conclusion, I would suggest that consideration be given to the undercutting and under-rolling of a small portion of the wheel fit just within the hub face, and that, if possible, particularly if the part is subjected to corrosion, that cadmium plating be used for additional protection. Corrosion will cut the endurance limit of a steel to 50 per cent of its value and no finish which is subjected to corrosion will give security. Undercutting or under-rolling will eliminate corrosion due to friction. Cadmium plating will eliminate that due to moisture. A combination of these two methods should greatly increase the life of crank pins. It must not be forgotten, however, that the under-cutting and under-rolling must be free from tears in the metal or grooves, and that there must be no square corners.

Caboose Deluxe.—There's a story behind the little red caboose in the yard of former Sheriff Shields of Great Falls, Mont. Its days of wandering are over but, unlike the dismal end of most railroad cars, this one is still on its own wheels and they rest on real rails and ties. The former sheriff happens to be one of the old-time railroaders of the Northwest. But now he's retired. The caboose, however, is not merely a reminder of his period of service for the Great Northern. This caboose, in fact, has gone quite high hat. Its interior has new and strange things mingled with the equipment customarily found in rolling stock of this kind. It's ex-sheriff and ex-conductor Shields' improvement on the fad of turning the basement coal bin into a recreational room.

EDITORIALS

Progress in Weight Reduction

The Chicago, Milwaukee, St. Paul & Pacific passenger-train cars recently built for the "Hiawatha," which are described in this issue, represent an interesting further step in the development of reduced weight equipment which that road first undertook in 1934. In the first designs the weight reduction was obtained by a careful distribution of metal in the structure, by employing welding in place of riveting in construction, and by utilizing light-weight materials for interior finish. A unique feature of the original design was the formation of the side panels in pans which, in effect, made the side sheathing and frame members integral.

The second step, aside from modifications in the details of construction, involves a change from carbon steel to Cor-Ten steel as the material for the underframe and superstructure. The overall result of the changes in material and in the detailed construction is a reduction in weight of the coaches from about 56 tons to 46 tons. With the exception of the stainless-steel coach of the Santa Fe and the aluminum-alloy coaches on the Baltimore & Ohio "Royal Blue" these are the lightest weight coaches fully equipped for long-distance service which have yet been built to dimensions interchangeable with present standard equipment. All of these weights include air-conditioning equipment.

Prior to the advent of the new materials of construction, such as the strong aluminum alloys, stainless steel and the new low alloy structural steels, few, if any, passenger cars for main-line passenger service have been built which do not weigh well over 50 tons. A number of relatively short coaches (62 ft. to 63 ft. body lengths) have been built with weights of 52 to 56 tons. With a few notable exceptions the cars of 70 or more feet in length have weighed from 65 to 80 tons. The Boston & Maine has a lot of 70-ft. coaches which weigh less than 60 tons and the Pennsylvania P70 class coaches have been built with weights running from slightly below to slightly above 60 tons.

Not only have the new materials, therefore, resulted in definite improvements in the weight situation by their application, but they have also stimulated a new interest in refinements in design which are contributing to improvements in the weight efficiency of passenger-car designs irrespective of the materials of construction.

Not the least effective of the factors entering into weight reduction in the lighter weight coaches is the use of the four-wheel truck. Only the lightest of the 70-ft. coaches are carried on the four-wheel trucks. Most of those weighing 65 tons or more are carried on six-wheel trucks, largely for the sake of improved riding qualities, with a resulting material increase in the total weight of the cars due to the trucks alone. With the continued development of alloy-steel springs the higher fibre stresses which they make permissible should provide for the development of improved riding qualities in the four-wheel trucks which, in cars of light and moderate weights, should be equally as satisfactory as is obtainable from present-day six-wheel trucks.

Car and Locomotive Orders

Orders were placed during the month of October (up to and including the 29th) for 22 locomotives, 1,310 freight cars and 5 passenger cars, for domestic use. This brings the totals for the first ten months of the year (excluding the last few days in O tober), as reported in the issues of the Railway Age, to 180 locomotives, 38,664 freight cars, and 154 passenger cars, to which must be added orders for six light-weight trains with an aggregate of 56 body units, either partially or wholly articulated.

Reference to the table will show that this is more than twice as many, in all instances, as the total orders placed during the entire year 1935. Indeed, the totals up to date for this year measure the high mark for the past six years, except for 1934, when the Pennsylvania Railroad ordered an unusually large number of electric locomotives for its New York-Washington service, and when the Erie and New Haven gave relatively large orders for passenger cars. The totals thus far this year, however, by no means measure up to the orders during the year 1930, and these, again, are relatively small as compared to the average orders for the five years 1925-1929, inclusive. The orders thus far for 1936, how-

Equipment Ordered for Domestic Use

	Locomotives	Freight cars	Passenger cars
1925-9 (inc.), Average	981	78,854	1,980
1930	440	46,360	667
1931	176	10,880	11
1932	12	1,968	39
1933	42	1,685	6
1934	183*	24,611	388†
1935	83	18,699	63
1936 (to Oct. 28 only)	180	38,664	154‡

* 73 of these were electric locomotives for the Pennsylvania.
† 133 of these coaches were for the Erie and 50 for the New Haven.
‡ To this must be added 56 body units in six light weight articulated trains.

ever, do reflect the increased traffic which has been handled by the railroads during the year.

There are now outstanding inquiries for 145 locomotives, 896 freight cars and 18 passenger cars. Action on some of these had been expected before this time, but the supposition is that uncertainties as to the results of the election have held them back. The election will be decided before this number of the *Railway Mechanical Engineer* reaches its subscribers. Railway freight traffic, measured by the weekly reports of the carloadings, has been holding up exceptionally well and during the month of October established high records for recent years. It is quite likely that before the year is closed the figures for equipment ordered will likewise mark an unusually high point.

The Whistling Nuisance

One of the characteristics of our machine age has been the excessive amount of noise—harsh noises in many instances which have been detrimental to health and comfort. The railroads have been among the leaders in this respect.

The detrimental effects of noise have become more and more marked as new forms of transportation have come into being, such as the street car, the automobile and airplane. Fortunately, much scientfic research has been devoted to this problem in congested cities in recent years, and determined efforts are being made in many places to reduce it to a minimum.

One particularly irritating noise, which has brought much criticism on the railroads, has been that of the locomotive whistle. Whistling cannot be avoided, because of the many grade crossings. Attempts have been made, however, to change or improve the tone of the whistle so that it would prove less distressing and disagreeable. Recently the Florida East Coast equipped a locomotive with six different types of whistles. It was run over the road on a special train and demonstrations were given in 19 different cities. Announcements of these demonstrations were made in the press and by other means, and ballots were distributed and as many collected as possible. Apparently it is the intention of the railroad to equip all of its locomotives with the type of whistle meeting with the most widespread approval. At one time, before the research was completed, 95 per cent of the votes were said to favor one particular whistle.

The press gave considerable attention to this unique experiment, and the whistle which was most widely favored at the time was characterized by one newspaper commentator in these words: "Anyone who has ever been awakened at two o'clock in the morning on an ocean voyage by the bellow of a fog horn, will recognize it in a moment." Another whistle was said to be "harsh toned and shrill; its merest utterance made you feel as if you would like to go out and fight a policeman." Another was likened to a "high shriek of agony across a wilderness at nightfall." Incidentally, these comments refer to whistles of the steam type. Three other whistles were operated by air. Apparently they did not meet with approval. One of them, for instance, was likened to a "factory whistle resounding at the close of day across the rooftops of a crowded city"; another as a "dying calf siren, hardly audible two squares away." The tones of another whistle of this type "evidently died on the way, as none reported having heard it."

The Florida East Coast is to be commended on this effort to provide a whistle which will prove effective in service and yet will produce a minimum of irritation. The American public, particularly in the vicinity of our large cities, is showing a disposition to be exceedingly critical of all unnecessary noise. It therefore behooves the mechanical departments of our railroads to give special attention in the designing of locomotives and cars, to insure that every possible step is taken to insure their operating as quietly as possible. It will be better to anticipate a growing antagonism on the part of the public toward nuisances of this sort, and take constructive measures to improve conditions before they reach a point which will result in controversy and retaliation on the part of the public.

Competition in Equipment Design a Sign of Progress

Most of the men in positions of responsibility in the mechanical departments of American railroads today have not forgotten the statements of some of the enthusiastic proponents of electrification about twenty years ago to the effect that the day of the steam locomotive was over and that it would only be a matter of time before most of our railroads would be electrified. What has happened since is a matter of history. The steam locomotive is still with us and, in spite of the fact that during the past twenty years its development has been the most intensive of any similar period during the hundred years of its existence, its supremacy is now being challenged again. The Diesel has entered the picture and even in the comparatively short space of five years the progress that has been made has caused some to suggest that steam is decidedly on the defensive. Now, within recent months, back comes steam in the form of the turbo-electric, such as the Union Pacific proposes to build, and the high-pressure rail train, such as the one on the New Haven described on page 485 of this issue, to challenge the right of the Diesel to monopolize the transportation scene.

All of these forms of rail motive power will eventually find only that place in the railroad scene which can be earned by proof of their economic value. What

is important is that the railroad industry has the vision not to dismiss any new form of motive power which is offered to them without a thorough trial to disclose its possibilities. Out of these trials are developing new tools which do not displace the older and time-tried implements of the industry, but rather supplement them. The result is a change in emphasis toward specialization and away from standardization, the stimulating effects of which are being felt not only throughout the railway organization, but also by the public.

Accidents Are Costly

F. H. Williams in his article on Failures of Locomotive Parts, elsewhere in this issue, confines his comments to the crank pin, and only to that part in the wheel fit or immediately adjacent thereto. Researches have shown, to his own satisfaction, at least, that the utmost care must be given to insure the elimination of even minute surface imperfections in the machine finish. Is this worthwhile?

It seems to be the impression that crank pins usually fail when the locomotive is starting or stopping, and not when it is operating at high speed. Whatever the facts may be in this respect, it is a matter of record that crank pins do fail when the locomotives are operating at high speed. Such an accident on an eastern railway recently resulted in damage to the extent of $30,000.

Mechanical-department officers are seriously concerned with this problem of the breakage of crank pins. Certainly, the direct cost of such accidents to the railroads today is so great that unusual pains can well be taken to avoid them. If Mr. Williams is right in his contention, then his recommendations should be followed; if he is wrong, the sooner it is determined, the better, in order that effective measures may be taken to eliminate the weakness. Is he right? Is he wrong?

NEW BOOKS

Locomotives. *By A. M. Bell. Published by Virtue and Company, Ltd., 19-21 Thavies Inn, Holborn Circus, London, England. 424 pages, 9 in. by 11 in., 2 volumes, cloth binding. Price 37s. 6d.*

In these books (second edition) the author takes up the subjects of steam locomotive construction, maintenance and operation. After this, in a briefer manner, sections are included on electric, internal-combustion and other forms of motion power. Both volumes are well illustrated by line drawings and half-tones. Several are on large size, folded sheets and a number are printed in colors. The frontispiece—on a sheet 11 in. by 19 in.—shows a phantom sectional illustration of the "Lord Nelson," a four-cylinder 4-6-0 express locomotive of the Southern Railway (Great Britain) on which 260 parts are numbered and named.

Volume I is devoted mainly to matters of design and construction of detail parts, as indicated by the nine chapter headings which are as follows: general description, boiler, superheating, cylinders and valves, framing and wheels, lubrication, tenders, continuous brakes, feedwater. In Volume II the subjects are: repairs, maintenance, combustion and fuel, running faults and failures, shop arrangements, enginemen, special types of steam locomotives, internal-combustion and electric types, modern types of locomotives. Among the special types illustrated and described are turbine locomotives, Beyer-Garatt articulated, Franco articulated and condensing locomotives. The modern locomotives chosen are those on British roads or those built by British companies for export.

While these books do not deal with American locomotives or with shop practices in this country, they yet contain much of general information, particularly to younger men. An excellent index is given at the end.

Corrosion Resistance of Metals and Alloys. *By Robert J. McKay and Robert Worthington. An American Chemical Society Monograph published by the Reinhold Publishing Corp., 330 West Forty-second street, New York. 492 pages, 6 in. by 9 in., illustrated. Price, $7.*

The purpose of this work is to summarize the facts on corrosion processes and rates. Data from experience and test on the action of alloys, under given conditions, form the main part of the book. The preliminary part attempts to classify and explain the important points of the general theory and mechanism of corrosion. While the data offer no panacea for corrosion difficulties, a combination of data from Part II with the general facts of Part I should enable the reader to reason for himself on corrosion problems on which direct information is not available. The materials which are dealt with in Part II are magnesium and its alloys, aluminum and its alloys, zinc and zinc coatings, cadmium plate, tin and tin plate, lead, iron and steel, silicon-iron, molybdenum and chromium plate, nickel and nickel-iron and nickel-copper alloys, copper and high-copper alloys.

Dictionary of Mechanical Engineering Terms. *By J. G. Horner, A. M. I. M. E., and E. H. Sprague, formerly M. I. M. E. and A. M. Inst. C. E. Published by the Technical Press, Ltd., 5 Ave Maria Lande, Ludgate Hill, E. C. 4, London. Price, 12 s. 6p.*

The Appendix to this sixth edition of the (British) Dictionary of Mechanical Engineering Terms, comprising approximately eight thousand definitions of terms used in the theory and practice of mechanical engineering, has been enlarged to include several hundred additions relating to the advances in engineering practice. Only terms of universal, or of moderately wide application are defined.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

One Satisfied Subscriber

May I say that I owe your magazine a lot in getting my promotion. After subscribing to and reading it for several months I had occasion to talk with the road foreman of engines. I was then a valve setter in the roundhouse and our discussion revolved about engine repairs. I had read a number of good articles in the magazine that gave me some constructive ideas and these were passed on to the road foreman, with the result that I was promoted. I have since found the *Railway Mechanical Engineer* helpful, in that it keeps me abreast of the times. I am not much of a hand at reading magazines, but I can't wait until your next issue gets to me, and I literally "eat it up."

Poor Salesmanship

Some time ago I received a form letter suggesting that I "wake up" and discover for myself, as so many other progressive industrialists had already done, that their machine would cut down costs at least 50 per cent, and that the entire cost of the machine might be recouped in a year, since it was so much more efficient than the one we were using. My reply to this was: "If your advertising department was as wide-awake as your sales department you would know that several years ago we installed one of your machines, purchased through reading a very intelligently written description of it in the advertising pages of a well known technical magazine. But, if this advertisement had made the absurd claims found in your circular, we doubt very much if it would have interested us at all. Your machine is giving very satisfactory results and is all your salesman claimed, but it would take several years to pay for it with the savings made. You should know this particular machine could not possibly be used but a small proportion of the time in a shop of our size; in fact, it is not used more than 25 per cent of the time. When it is in use it is possible to perform the work about 10 per cent faster than the machine it displaced, and it only displaced the old one because of its having been in service 28 years. We are satisfied with it and possibly were 'awake' before the writer of the circular was employed to write it."

A "Budding" Foreman

Some of the younger men in our shops feel that the older supervisors should retire at 65 years of age in order to give them a fair chance. One who appeared to be feeling the worst over it—who claimed to have given the matter of adequate supervision much study, and had taken a part course on the subject and felt his time wasted if he never got an opportunity to demonstrate his ability—was recently given a two weeks' trial, when one of the foremen was on a vacation. Meeting him one day, the superintendent of shops asked him how everything was going along.

"Fine, sir; very fine, indeed."

"Well, I'm glad to hear that Joe. But do you know that some months ago it was decided to discontinue using a file on our lathe work; that a better job would be made with a tool, if proper care and skill were used?"

"Yes, sir, I do," the young man replied. "Old Bill, my foreman, discussed that with me at the time and I quite agreed with him. And in one of my lesson papers, it——".

"Never mind the lessons just now, Joe. I passed by the man on the crank pin lathe over there about 10 minutes ago and he sure was busy with his file. You can see from here he is still filing."

"Well, I didn't happen to notice it, but I'll go over and tell him about it."

I later learned that this is in part what was said by Joe: "Say, you big So-and-So, the Old Man has been watching you filing that wheel fit for several minutes. You know as well as I do that filing is out. He's just bugs on that subject. Keep your eyes open when he's around. I just got hell over it."

I later called Joe in and had a heart-to-heart talk with him. He admitted it. But I wonder if any reader, a budding foreman especially, would care to say what he thinks was said to Joe, or will anyone say just what he thinks Joe should have been told.

Photo by H. C. Wilcox

A Critical Moment

Noon-hour recreation in the wheel shop of the New Haven at Readville, Conn.

IN THE BACK SHOP AND ENGINEHOUSE

Several different types of crane hooks used in applying locomotive parts at the C. B. & Q. shops, Denver, Colo.

Material Handling Devices At Denver Shops

One of the notable features of the large locomotive shops of the Chicago, Burlington & Quincy at Denver, Colo., is the unusual number of special devices developed in the course of the past few years to save time and labor in handling locomotive parts in the erecting shop. Several of these devices, resting on the shop floor, are shown in one of the illustrations.

For example, the spring lifter *A* can be suspended from the crane hook and used by one man in applying or removing driver and trailer springs. The device consists essentially of a hook made of 2½ in. round steel, bent at two places to 45 deg. and 90 deg. angles, respectively, and having a pair of jaws welded to one end to engage the spring. These jaws are spaced 15 in. apart and it is approximately 54 in. from the jaws to the link in the other end, which engages the crane hook. The right-angle bend in this lifter is stiffened by welding to it a triangular plate made of ⅜-in. steel, 15 in. long on each leg of the triangle.

At *B* in the illustration is shown a similar but smaller crane hook made of 2-in. round stock with a link in one end and the other slightly flattened and provided with a drilled hole to engage a bolt in the back valve chamber head and be used when applying or removing this somewhat awkward-shaped locomotive part.

The usual type of air reservoir lifting device is shown at *C* in the illustration, being 15½ ft. long, lifting arms spread 32 in. apart, and made of 3-in and 2-in. stock. This device is spring-supported from the shop crane to avoid possible damage to reservoir bracket studs or breakage of the hook, due to over-travel of the shop crane in lifting. Devices of the same general character, used in lifting 11-in. and 8½-in. air pumps are shown at *D* and *E* in the illustration, being made of 4-in. by ¾-in. steel, and having lifting arms arranged for convenient attachment to the pumps.

The device shown at *F* in the illustration is a strongly-made and rigidly-braced hook for use in applying crosshead and guide assemblies. This device is made of 4-in. by 1-in. stock, 8 ft. long from the link to the lifting arms which are spaced 32 in. apart and provided with round holes in the ends for secure attachment to the crosshead and guide assemblies.

A special hook for use in applying Elesco feedwater pumps is shown at *G* in the illustration, being made of 4-in. by 1-in. flat stock. Incidentally, the back ground of this picture shows a washout-hole reaming device, very effectively used for reaming and tapping out washout and arch tube plug holes. The device is driven by a reversible pneumatic motor arranged to drive the drill or tap socket through an adjustable power shaft 10 ft. long and equipped with a 1-to-20 worm-gear drive on the lower end.

A very satisfactory binder-lifting device, mounted on two wheels and provided with a 12-ft. handle to give the necessary leverage, is shown in a separate illustration. This device is made in general of ¾-in. stock 2 in. and 3 in. wide, the special binder clamps being supported by chain links from a hook which is about 45 in. from the floor. The upper triangular bars of this device are provided with holes spaced so as to make the lifting hook adjustable for height to meet the requirements of various classes of locomotives. By the use of this lifting device, a heavy locomotive binder may be taken from the floor and placed in position on the pedestal jaws ready for application of binder bolt nuts by one man.

Still another device used in applying stokers, superheater headers, etc., is shown in another illustration. This device consists of an A-frame, each leg of which is made of two 9-in. channels bolted together and having the outer ends of the lower channels spread and equipped

A-frame which greatly facilitates removing or applying stokers, superheater headers, etc.

A convenient device for applying binders

with a 3/4-in. steel plate 14 in. by 29 in. to which the superheater header can be bolted. The bottom channels are 16 ft. long and the angular channels, to the upper end of which the crane hook is attached, are 14 ft. long. The steel cross plate of the A-frame is made of 1/2-in. stock 17 in. wide and the angle at the junction of the 9-in. channels is approximately 35 deg. The steel plate to which the crane U-bolt is attached is provided with a series of holes drilled 2 1/2 in. apart so that the point of attachment to the shop crane may be varied, dependent upon the weight being lifted.

This and numerous other lifting devices used at the Burlington shops are designed not only to permit applying and removing locomotive parts with a minimum expenditure of time and labor, but also to make sure that this work is done with maximum safety. There is always more or less potential danger when applying or removing heavy locomotive parts, but the use of properly designed lifting devices, such as those illustrated, removes most of the physical labor otherwise necessary, prevents the possibility of strained backs and limbs, and avoids the necessity of shop men getting into relatively dangerous positions.

Gage for Setting Tires On Wheel Centers

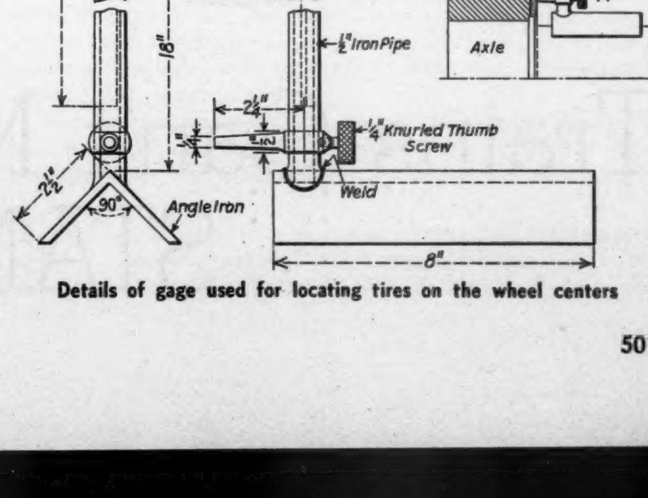
Locomotive tires that have been set on the wheel centers by a slip-shod method usually cause delay and waste of material when the wheels are placed in the wheel-lathe for truing the tires. If the tires are cocked the forming tool will not cut a true flange; therefore, the wheel must be returned to the floor and the tires reheated and adjusted on the centers.

To overcome this delay the gage shown in the drawing was made and is used to set each tire square with the journals and axle center line. If the gage is used with reasonable care, the tire will run true when placed in the wheel-lathe, also the tires will gage equal distances between flanges.

The construction is simple. The dimensions shown are all that are necessary to build the gage for all size locomotive tires.

There are three adjustments, *A* at the hub liner, *B* at the tire and *C* for the height. The distance between the hub liners is measured with a slip tram and this distance is subtracted from the back-to-back distance between the tires, that is 53 3/8 in. or 53 1/4 in. Should this distance show that the tires must be set 1/8 in. wider than the hub liner faces, adjust the pointer *A* to center of hub liner and adjust the screw *B* until it is 1/16 in. longer than *A*, then adjust the height of *B* by the set screw *C*. While the tire is hot and with the angle iron base on the journal, slide the jig until the pointer *A* is touching the hub liner and adjust the tire to touch the pointer *B*. When the opposite tire is applied, use a 53 3/8-in. or 53 1/4-in. tram between the tires, checking four or more different points around the tires.

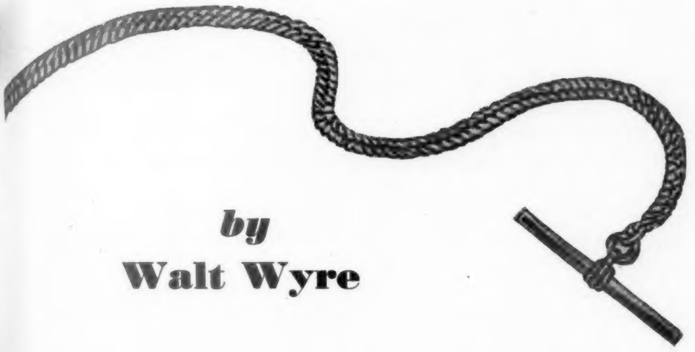
This method will set the tires square with each other as well as with the axle centers, thus eliminating any further trouble to the wheel lathe operator.



Details of gage used for locating tires on the wheel centers

Hawkins wiped the clock and opened the sanders, but the train lacked eight feet of stopping soon enough

Trains Can't Make Time STANDING STILL



by
Walt Wyre

A NEW time-card was out on the S. P. & W.—a time-card with schedules faster than most any one had dreamed possible a few years back. Everything was speeded up. The Limited, already considered pretty fast, had six hours lopped off the time between Chicago and the Pacific coast. Freight trains showed a scheduled time that was the boast of crack passenger trains not long ago. Division superintendents that had been in on the new schedules wondered if it would be possible to make the time. It looked less possible when seen in the obdurate figures of the time-card than when being discussed.

Superintendents had agreed that with all conditions favorable the time could be made over their respective divisions when the time-card was being considered. Some of them may have had their fingers crossed and a prayer in their hearts that they would never have to demonstrate the fact when they concurred with the general manager that such speeds were entirely possible. Then, too, the power of suggestion goes a long ways, particularly when it's the general manager doing the suggesting and he intimates that any who fail to agree with his suggestion might be given the opportunity to look for more amenable superiors.

At any rate, all of the superintendents agreed that the schedules indicated were entirely possible. Some of them voiced mild protests that became weaker under the glare of the g.m. Now that the schedules were an established fact and the general manager miles away, many of them wished they had protested more violently. If they had it to do over, they would, they told themselves. Besides, it wouldn't be any worse to get demoted for failing to agree than for failing to run trains on impossible schedules.

Trainmasters, when they received the new time-card, looked it over and scratched their heads. Most of them reached for a pencil and pad of clip and began to try to figure how minutes could be clipped off the time required to get trains through terminals. The less optimistic ones thought of how it would be back on their old jobs that they had before being promoted.

Master mechanics shook their heads and asked for the last engine failure report, not that any of them needed the report to tell just how many engine failures had occurred on his division the past thirty days. If there were too many to remember he had already made arrangements to move to a less responsible position. Ones that had a bad record of engine failures wanted to figure how many more would be too many. Ones that had a record showing few failures or none wanted to see how the record would look with a flock added on. All of them figured that at the best engine failures would be more numerous and the assumption was reasonable. Increased speed meant increased wear on moving parts and more friction to cause hot pins and hot boxes.

The Plains Division received the hardest jolt of all with the new time-card. Train speeds already fast were stepped up so high that it seemed throttle quadrants would have to be lengthened if the trains made the time.

T. E. McGinnis, superintendent of the Plains Division, voiced a protest when the schedules were suggested.

"But, Mr. McGinnis, your division is almost as level as a floor and straight as a string. The road bed is as good as can be found and with that new heavy steel —of course, if you think we are too out of date—."

McGinnis knew that the g.m.'s "we" wasn't intended to be plural at all. The superintendent caught the drift and said no more.

The schedule went into effect Sunday at 12:01 a.m. and the trouble started.

Seventy-one and 72's "on time" performance record looked like a tank-town college football score against S.M.U. At first the super received letters merely suggesting that it was very important for the Red Ball freights to run on time. Evidently the locomotives had never heard of Coue, or whoever the Frenchman was that expounded the theory of "every day in every way, I'm getting better and better," for "on time" performance didn't improve. The superintendent called a meeting of the trainmaster, master mechanic, and road foreman of engines.

"Gentlemen," the superintendent drummed nervously on his desk with a pencil, "you all know that our 'on time' performance has been er—ah—deplorable."

H. H. Carter, the master mechanic, nodded approvingly. Deplorable was the word he would have used, and did, at every opportunity.

"The performance is deplorable. There's something wrong. What we want to do is find the trouble and correct it." The superintendent glanced questioningly at the three men seated across the table from him.

"Well, we're doing our best getting the trains through the terminal," Wally Robinson, the trainmaster, said, "and making pretty good time at it, too," he added, which shifted the responsibility.

"How are your locomotives?" McGinnis looked at Carter.

"Our power is in pretty good shape. In good shape, I'd say. Our record of engine failures—only two last month—speaks for itself." The master mechanic spoke very emphatically.

Bob Lane, the road foreman of engines, squirmed uneasily. Everything else was going good, which left it up to him. He didn't wait to be questioned. "Well, it looks to me like a case of too much trains to make the time. You know, there's seldom less than ninety cars on 71 or 72 and the time is pretty fast."

"Yes, the time is pretty fast, but so are the locomotives, and they're not pulling more than their tonnage," McGinnis interrupted. "I want you to ride the engines, and you, too, Carter, and find out why they're not getting over the road. And you, too, Robinson, ride the trains, particularly 71 and 72. I'm going to ride them, too. Other divisions are making the time and there's no reason why we can't." The super glared as though he dared either of them to deny it.

After a little further discussion the meeting adjourned with nothing more definite determined than that each official and department was doing the best job of railroading possible and the trains were not consistently making the time.

The trainmaster rode the trains; the master mechanic and road foreman rode the locomotives. Nothing happened except the officials got behind with their sleep.

THEN business took a seasonal slump and trains were lighter. Seventy-one and 72, instead of being 90 to 100 cars or more, were cut to 60 and 70 cars and made the

time. Twenty-eight hundred class locomotives made the run with less effort than the 5000's had made it with the heavier trains, which didn't check according to their respective ratings.

"It's them 500 engines," the trainmaster said. "They're not what they're cracked up to be!'

"Like hell it is!' the master mechanic snapped. "They're good engines; if they weren't, they wouldn't stand the beating they get pulling sixteen coaches on the Limited, half of them Pullmans, air-conditioned, too."

"Well, it's quite evident there's something wrong," the superintendent cut in. "The 2800's are making the time with their rated tonnage and the 5000's didn't do it. Perhaps there's something in what Robinson says. Maybe the locomotives in passenger service are in better condition than the ones used on freights."

Carter made a rumbling sound in his throat when he swallowed the retort that was on the tip of his tongue. "Well, I'm going to find out what the trouble is when business picks up—and it won't be the locomotives, either!"

The opportunity came sooner than expected. Two weeks later there was an unexpected demand for grain cars in Kansas. The current wheat crop was light, due to drought conditions, and no one looked for a heavy wheat movement. A sudden upturn of the market brought a rush of wheat out of storage and elevator operators were yelling for cars, and they wanted them right now.

Seventy-two, that usually carried nothing but hot-shot merchandise and perishables, was filled with empties.

Carter was at his desk frowning at the amount of overtime worked in the Plainville roundhouse the previous month, when the phone rang.

"Yes, this is Carter," the master mechanic snapped. "Oh, yes, Mr. McGinnis."

"Train 72 lost an hour and forty minutes yesterday," the super said, "with a 5000 pulling it."

"How many cars?"

"Hundred and two—sixty-five empties," McGinnis told him.

"I'll ride 72 this afternoon," Carter replied.

"Let me know how you make out," the superintendent replied.

Seventy-two was due to leave Plainville at 2:45. According to the lineup, it would get in about 2:10 with 48 loads with a 2800 pulling it. Fifty-five empties were to be added to fill at Plainville.

Carter went to the roundhouse before noon to see what engine was being used on 72 and what condition it was in.

"Figuring on using the 5084," Evans, the roundhouse foreman, told him.

"Why not use the 5091? Ain't she a better engine?" Carter asked.

"Yes, but I figured to use her on the Limited." Evans bit off a hunk of "horseshoe." "The 5091 is a good engine."

"Use her on 72."

Evans turned his quid of "horseshoe" with his tongue. "O.K.," he said.

The master mechanic looked over the 5091 like a government inspector with a grudge against the roundhouse foreman. He even looked at the tank box packing and crawled underneath the engine. He found a screen that didn't fit the journal to suit him and had it replaced.

At 2:45, Shorty Hawkins, the engineer gave two inquiring toots of the whistle. The car inspector waved his hat—O.K. The conductor standing by the engine said, "High-ball," and started walking back towards the caboose. The hoghead shoved the air reverse lever all the way ahead and opened the throttle. With the booster helping, the train started almost as smoothly as a switch engine with the President's business car. The head brakeman waiting at the switch let them out on the main line. He caught the engine and climbed aboard. The rear brakeman would close the switch.

Gradually the train picked up speed, Shorty Hawkins working a light throttle. When all but about ten cars were on the main line, the engineer closed the throttle and let the train drift. The brakeman dropped off the front steps of the caboose to close the switch. The instant the caboose was in the clear, the shack swung on the switch lever.

"What do you say? Is he ready to go?" Hawkins asked the fireman.

"Seems to be having trouble closing the switch," the tallow pot replied over his shoulder. "He's giving a stop signal."

The engineer looked at the ground. The train was rolling faster than he thought. With the train a few car lengths ahead of him, the brakeman would have a hard time catching it. The hoghead applied the air lightly, just enough to drag the brake shoes on the rolling wheels.

In the meantime, Carter was leaning anxiously out the gangway, craning his neck to watch the brakeman. "You'll have to slow down more or he'll never make it," the master mechanic said. "He's got it—he's running after the caboose—nope—he's give up."

The engineer again applied the air, making a reduction of about ten pounds.

The rear brakeman waved his cap with one hand and caught the grab iron with the other.

Hawkins widened on the throttle a couple of notches. There was a slight jerk as the slack ran out on the head end cars; still the train got slower. He opened the throttle wider. The drivers spun. He closed the throttle and opened the sander valve. Again he opened the throttle and cut in the booster. The train continued to lose speed.

"What's the trouble?" Carter asked anxiously.

"Damned brakes dragging. Must be some bad leaks in the train line." Hawkins closed the throttle and the train stopped almost immediately.

"Won't she pull it?" Carter asked.

"Yeah, she'll pull the ones ahead of where the brakes are sticking and take a draw-bar with 'em if I give her the gun," Hawkins replied as he "hossed" her over in reverse to take slack again.

He waited a minute and tried again. The train started reluctantly, dragging hard for two or three minutes.

Carter looked at his watch. "Five minutes or more lost getting out of town on account of a brakeman being slow." The master mechanic made a notation in his little black book.

"Account of brakes being slow, you mean," the engineer yelled as he pulled the reverse lever a couple of notches nearer center. The master mechanic scratched his head, then made another notation in the little black book.

Gradually the speed increased. The exhausts from the locomotive became a staccato bark as the hoghead hooked her up that blended in a roar as the speed increased. The master mechanic looked over at the hoghead and grinned. They were rolling along.

By the time 72 reached the caution signal for the Santa Fe crossing at Guys, thirty-eight miles out of Plainville, the train had made up the lost time. The engineer closed the throttle and allowed the train to slow down to about thirty miles an hour. He leaned out of the cab and peered ahead for the crossing block signal. It indicated stop.

Hawkins applied the independent engine brakes grad-

ually to let the slack run in and he prepared to stop unless the signal cleared in time. He waited as long as he dared and applied the brakes. "Clear ahead!" Carter yelled as the signal changed.

But it was too late to keep from having to stop the train. The engineer slid to the ground and started looking around the engine. The master mechanic followed.

"Let's get going," Carter insisted. "We're losing time."

"Well lose more than that if we tried to start before the brakes are released."

The fireman stayed in the cab. The head brakeman dropped off before the wheels stopped rolling and started walking back towards the rear of the train. When about ten cars back, Carter saw him bleed the air off a car. The rear brakeman was coming towards the head end.

Carter fidgeted nervously while Hawkins puttered around the engine. After what seemed an hour to the master mechanic, the engineer climbed aboard and gave two long toots from the whistle. The rear brakeman finished bleeding the air from a car and waved a highball.

When the train reached Marlowe, twelve miles away, it was twenty-two minutes off on schedule time. That threw them on short time for a wait order and they ran into a red board at Middleton. The order at Middleton gave them more time on the wait order but cost another five minutes slowing down to pick up the order.

Carter made some more notes in his little black book.

Seventy-two had lost thirty minutes when they stopped for water at Beaver. The engineer made a nice stop and very little time was lost at the tank.

"How about making up a little time between here and Sanford?" Carter inquired at Beaver.

The engineer squirted a little oil on the right guide. "Can't do it . We'll be lucky if we don't lose more time."

The hoghead was right. They did lose more time. At Monroe, a city ordinance prohibits speeds of more than 20 miles per hour. The city Dads got sore when the Limited quit stopping there and passed the ordinance to get even. It doesn't hurt a light train so badly, but 72 lost at least another nickel's worth of time before it was again up to speed.

Hawkins had them rolling good about five miles out of Sanford, when he sighted a herd of cattle grazing on the volunteer wheat along the track. Orders are very definite: Do not kill any cattle when it can possibly be prevented. Hawkins didn't kill any cattle, but he did kill some very valuable time. A thick-necked Hereford bull defied the tooting whistle and hissing cylinder cocks by standing in the center of the track until the front coupler of the locomotive was almost touching the stubby horns of the white-face.

Again there was a wait for the brakes to release while Carter walked miles in the narrow confines of the engine deck.

The train was almost in to Sanford and almost an hour tardy on schedule time in spite of the fact that 5091 was performing nobly under the expert hand of Shorty Hawkins. He had her ears pulled back and was rolling along when he sighted a section laborer slowly waving his arms. The engineer closed the throttle and applied the independent air. When the slack was in, he made a service application.

As the train approached the section laborer he began to wave his arms faster until he looked like he was giving a pantomime of a Dutch windmill in a high wind.

Hawkins wiped the clock and opened the sanders, but the train lacked eight feet of stopping soon enough. The left front driver just barely eased to the ground where a rail was out. In the distance the rest of the gang of track laborers could be seen coming lickety-split with a rail to replace the one taken out. The one left behind to flag figured he had walked far enough.

"Why didn't you big-hole her?" Carter asked the engineer.

"Big-hole her?" Hawkins asked.

"Yes, make an emergency application," Carter said.

"I would if I'd known part of the track was gone, but after I made a service application it was too late then. You can't make an emergency application following a service application," the hoghead said, "—not with K-type triples."

Out came the little black book and Carter made another notation.

Seventy-two reached Sanford two hours late. That was the end of the engineer's run. The master mechanic had enough. He decided to let the next engineer take the 5091 without him. They walked over to the station together.

"What are you going to charge the delay to?" Carter asked.

"Time lost stopping," Hawkins replied, "and getting on the ground," he added.

"Couldn't getting on the ground have been prevented?" Carter asked.

"Yeah, if the snipe had flagged us sooner or if we had new type brakes so I could have big-holed her after making a service shot."

Carter made another note in his book.

NEXT day back in Plainville, Carter went to his office early. He barely stopped at his desk along enough to glance over his mail. He laid it all aside to be answered later except a traingram from the superintendent wanting to know about the delay on 72 the day before.

The master mechanic stuck the traingram in his pocket and went to some shelves in one corner of the office and began digging through a pile of magazines, books, and pamphlets. Most of them he laid aside; an occasional one he laid on the desk. When he had finished he had a dozen or more on the desk. Over two hours he spent looking through these and making notes.

About 10 o'clock, the phone rang. "Superintendent wants to talk to you," the clerk said.

"Tell him I'll be right over." Carter gathered up his notes and started.

"Well, it looks like Robinson was right about the 5000's not being able to make the time," McGinnis said in an 'I told you so' manner.

Carter's face reddened. "It's not the engines. It's the air brakes."

"The brakes! Why don't you fix them?"

"I don't mean on the locomotive. On the cars—they're out of date."

"They'll stop the trains, won't they? Besides, we don't want to stop 'em, we want to run 'em." McGinnis smiled drily.

"I set out to find out why our long trains don't make the time, and I believe I know," Carter persisted. "It's not the power, it's the brakes."

"But—" McGinnis interrupted.

"Just a minute, please, Mr. McGinnis. Wait until I finish." Carter piled a stack of papers on the desk topped with the little black book. "The type 'K' air brake equipment was a blamed good brake twenty-five years ago. If it hadn't been for it, railroads wouldn't have attained the speeds they have. It's still a good brake for short trains, but railroad operation of today demands long freight trains at high speed."

"I suppose you're going to suggest equipping all our

freight cars with 'AB' equipment. If you are, it's out of the question."

"No, I'm not going to suggest anything, but I'm going to give you the facts as I see them and let you make whatever recommendations you choose." Then Carter started in.

He told of the delays occasioned on the previous trip and how for the most part "AB" equipment would have prevented most of them, the derailment that might have been a serious wreck and cost enough to pay for equipping many cars with the improved brake.

"But they cost money—they're expensive to install," the superintendent said a little weakly when Carter had finished explaining.

"That's true. 'AB' equipment costs something, but it's not money wasted, it's invested. If I'm right in my opinion, and its partly based on experiences of ones in position to know, the AB brakes, in addition to allowing better running time would save enough to pay for themselves in a few years. "Look these over when you have time." Carter pushed the stack of papers and books toward the superintendent.

"Well, at least, you've given me something to think about and something to tell the general manager when I go in to the office next week to explain why we can't make the time on the Plains Division." McGinnis smiled wryly and reached for a letter.

Carter took the hint and left.

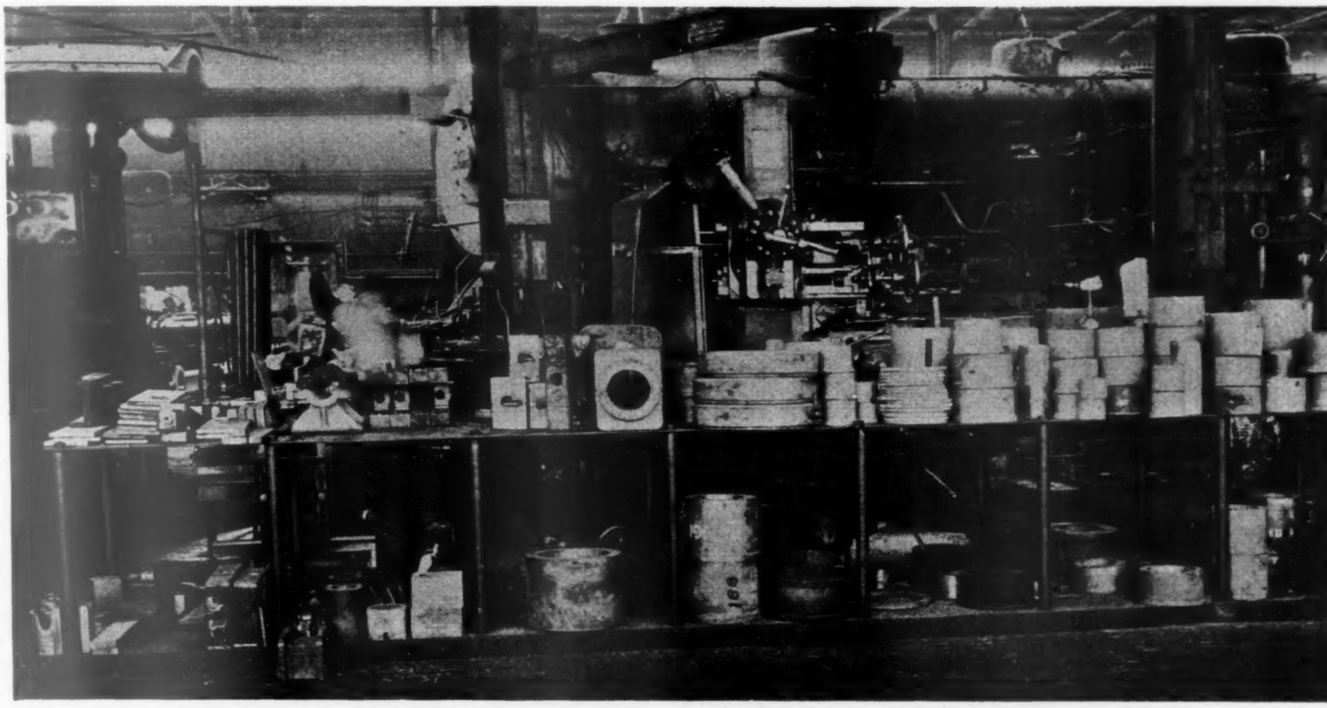
* * *

Brass Casting Rack And Chip Skids

An unusually neat arrangement, developed at the Denver, Colo., shops of the Chicago, Burlington & Quincy for the storage of brass castings, both before and after being made into rod bushings, is shown in the illustration. It consists of a special 8-section steel rack, 20 ft. long by 36 in. wide by 33 in. high, made of a heavy steel base plate and a ¼-in. steel top plate, separated by 33-in. boiler tube spacer nipples, through which one-in. bolts are applied to hold the plates together. Adequate provision is made for the heavier castings in the lower spaces and for those which are lighter and more readily handled on top of the rack. A 24-in. Bullard vertical turret lathe, used in the quick and accurate machining of these bushings, is shown in the background. Advantages of this rack include the possibility of segregating locomotive bushings by number, increased accessibility of these parts and assistance in keeping the floor orderly and clean. The Bullard turret lathe is used to meet the entire requirement of the shop for machining brass bushings of this type as well as miscellaneous other work.

In connection with this subject of machining brass castings, a special effort is made to handle brass scrap in such a way that a minimum of labor will be involved and a maximum return from the scrap realized. For example, three paper-lined lift-truck skids are assigned for the reception of different grades of brass chips. As shown in the illustration, the skid at the left is used for common brass borings; brass chips having a high lead content are stored in the center skid; and more or less unavoidable mixtures of brass and steel chips are stored in the skid at the right. In the latter case, an easy method of separation is to empty the chips on a smooth cement walk outside of the shop under the traveling crane where a heavy electro-magnet can be used to

Special paper-lined skids used in the segregation of various classes of scrap brass chips



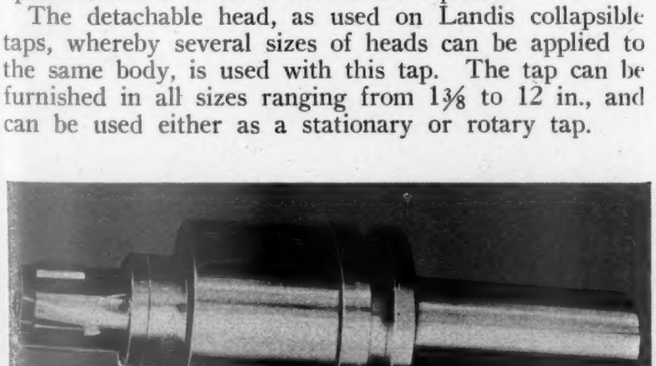
Brass bushing storage rack at Denver Shops—Bullard vertical turret lathe in the background

separate the steel chips and permit the remaining scrap brass to be returned to the skid or scrap platform and sold for a substantially higher rate than would be possible if it contained steel chips.

Yoke-Operated Collapsible Tap

A yoke-operated collapsible tap for use on automatic screw machines has been developed recently by the Landis Machine Company, Waynesboro, Pa. This tap, a modification of the Landis LT collapsible tap, is fitted with two flanges against which a forked yoke attached to the machine operates for expanding and collapsing the chasers. The chasers are collapsed by having a yoke contact the face of the flange near the front or chaser end of the tap upon completion of the desired thread length. The chasers are reset to tapping position by having the second yoke contact the flange near the shank upon the return travel of the machine spindle.

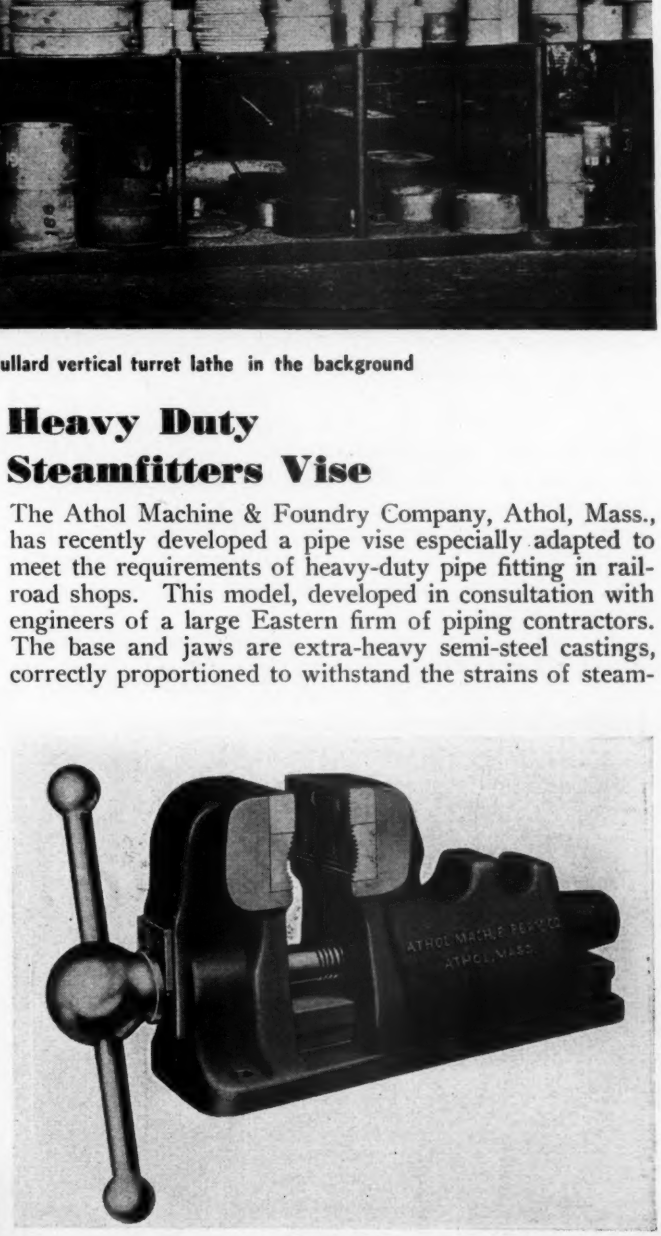
The detachable head, as used on Landis collapsible taps, whereby several sizes of heads can be applied to the same body, is used with this tap. The tap can be furnished in all sizes ranging from 1⅜ to 12 in., and can be used either as a stationary or rotary tap.



The Landis yoke-operated collapsible tap for use on automatic screw machines

Heavy Duty Steamfitters Vise

The Athol Machine & Foundry Company, Athol, Mass., has recently developed a pipe vise especially adapted to meet the requirements of heavy-duty pipe fitting in railroad shops. This model, developed in consultation with engineers of a large Eastern firm of piping contractors. The base and jaws are extra-heavy semi-steel castings, correctly proportioned to withstand the strains of steam-



Athol steamfitters' vise especially designed for heavy pipe work

fitters work. Note that the front jaw is fixed, and the back jaw moves, a feature that allows long pieces of pipe to rest upon the bench. There is no need for blocking or special supports as is the case when a movable front jaw brings the pipe out beyond the edge of the bench.

Large deeply-checked tool-steel flat-jaw facings, with straight section for ordinary work, are provided. The

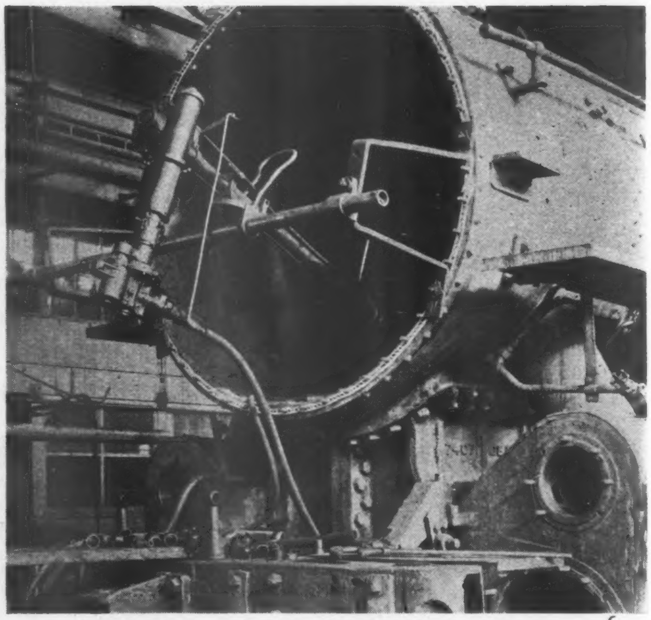
special pipe-grip sections have correctly shaped double-radius curves. Pipe of any size up to 6 in. is firmly held, as the shape of the jaw facing assures contact at several points, instead of at only one point on the pipe as with ordinary facings.

The exclusive Athol buttress thread screw is used in this new vise, and the screw is equipped with a removable nut. The buttress thread gives a full 50 per cent greater strength than a square thread of the same pitch. It is heaviest at the root, with its extra metal and extra strength just at the point where the strain is greatest. The Athol No. 1115 pipe vise handles pipe from 1/8 in. to 6 in., has jaws 5 in. wide, weighs 137 lb. and is available in the stationary-base type only.

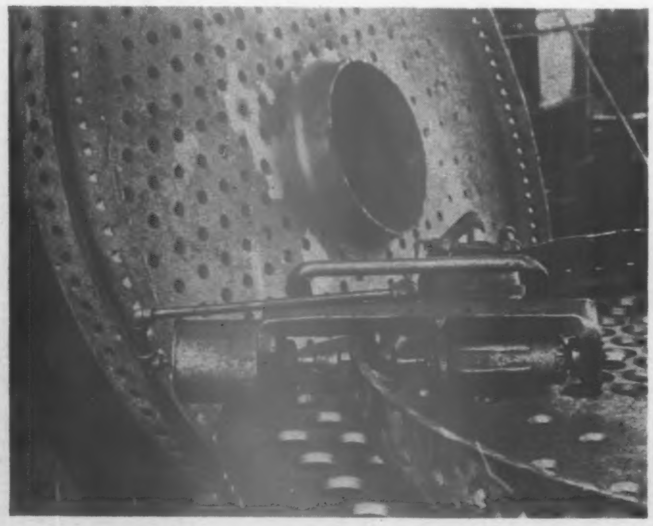
Two Boiler Shop Tools

Two devices which assist greatly in connection with boiler work at the Denver, Colo., shops of the Chicago, Burlington & Quincy are shown in the illustrations. The first is a power attachment for cutting off and rolling flues in the front end. This device consists of a reversible air motor with power attachment and worm-gear drive to a 6-ft. cutter bar, this bar being mounted on a 3-in. horizontal steel tube suitably supported by brackets bolted to the boiler front ring. A gear box makes two speeds available for use, dependent upon whether large flues or small tubes are being cut. Reference to the illustration shows that the cutter bar is capable of swinging vertically or sliding horizontally on the 3-in. horizontal tube. The machine may thus be used for cutting an entire set of flues without resetting the supporting bar and brackets, as required with most other types of flue cutting machines.

The cutter bar has a telescoping bar and universal socket arrangement to accommodate various lengths, dependent upon the angle of cutter bar adjustment necessary for any particular tube or flue. Only one knuckle joint is necessary with this arrangement, and in view of the rigidity of the drive, very satisfactory work is performed and a longer life assured for the cutters. The safety factor is also important, as the machine is strongly made and designed so as to present little opportunity for personal injuries. The rubber hose connection to the air motor and conveniently accessible control levers required for one-man operation are shown in the illustration.



Efficient power attachment for cutting off and rolling boiler tubes and flues



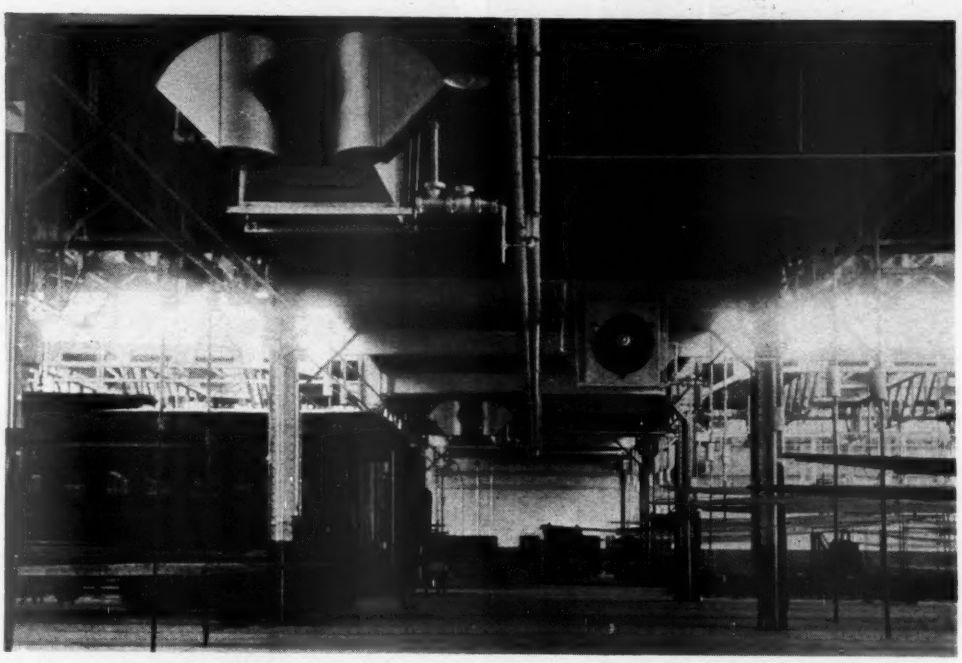
Easily handled device for counterboring rivet holes in flue sheets

The device shown in the second illustration is an unusually compact and effective arrangement for countersinking the rivet holes in flue sheets. This consists of a steel frame to which is attached an angle motor for operating the countersink and a small cylinder and air-operated plunger which backs up the countersink and provides the necessary feed. A convenient handle is welded to the frame for greater ease in adjustment of the device and the air line to the cylinder is installed and connected so that when air is applied to operate the motor, pressure in the cylinder pulls the countersink into the rivet hole. The overall length of this device is approximately 24 in. The cylinder has a 4-in. bore and 3½-in. stroke. The air line is made of ¼-in. steel pipe and the air pressure used is that of the shop line, or about 100 lb. per sq. in.

* * *

The use of a graduated scale on a steam hammer in conjunction with an adjustable pointer which may be set at zero avoids the necessity of calipering stock while being forged

With the Car Foremen and Inspectors



The paint shop showing the well-distributed daylight and the unit heaters mounted overhead

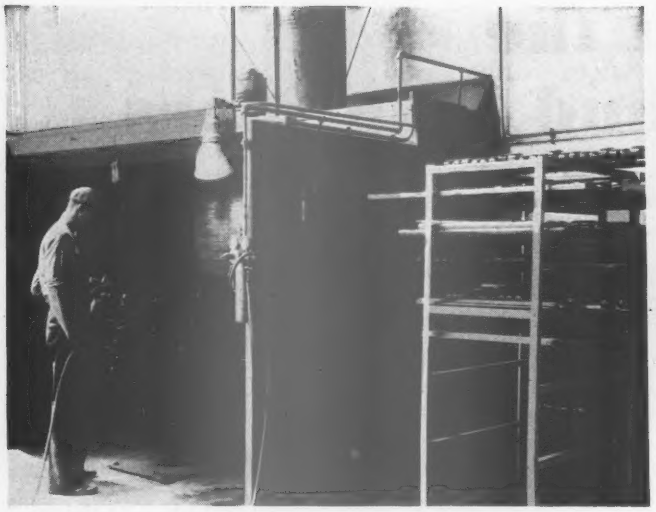
A self-propelled painting dolly which can be steered

Beech Grove Paint Shop

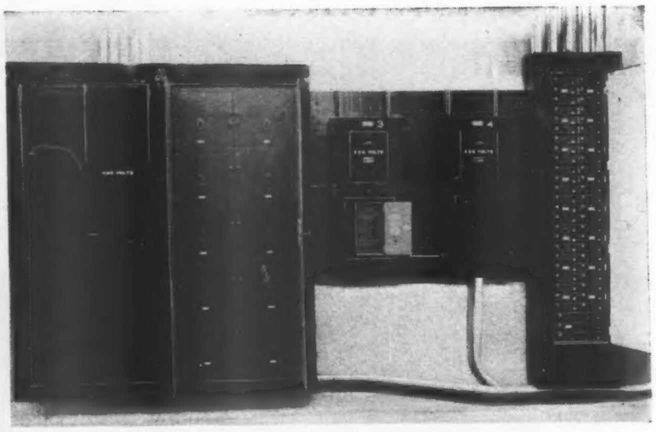
The passenger-car paint shop of the New York Central System at Beech Grove, Ind., was rebuilt in 1930, modern heating, lighting and spray-painting equipment being installed. Additional improvements have been made from time to time and the painting operations revised until this shop is now one of the best equipped passenger-car paint shops on the system.

The main building is 444 ft. long by 184 ft. wide, and houses 20 tracks, spaced on 20-ft. centers and made long enough to accommodate two cars per track. An 80-ft. by 97-ft. room is partitioned off on the west side of the shop at the north end and provided with forced ventilation and canopy exhaust hoods over Tracks 1 to 4, inclusive, which are used in all point-spraying operations on car exteriors and interiors. Tracks 5 to 17 are used in preparing cars for the spray room and trimming. Tracks 18 and 19 are scrub tracks and Track 20 is used mostly for special storage purposes.

Adjacent to the car-spraying room is an 82-ft. by 80-ft. room on the east side of the shop at the north end, used in the spraying of all parts of the passenger-car trim, furniture, etc., as well as certain roadway materials. The glass room, paint storage and mixing room, office, etc., are located in a 24-ft. by 124-ft. lean-to against the side of the main shop building adjoining the varnishing room. A similar lean-to on the east side at the south end of the building provides space for lockers, toilets, the electrical foreman's office and the battery-charging room. The south end of the main shop building is partitioned off for a distance of approximately 38



One of the spray booths in the varnish room



The large switches on the right are for canopy exhaust fans and those on the left for curtain fans—Switchboards are kept locked and can be opened only by those duly authorized

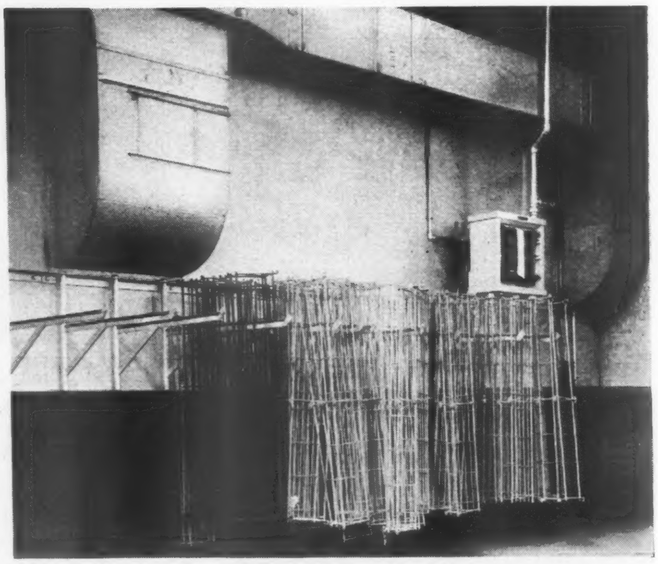
ft. to provide for a battery-washing room and an electrical workshop. The roof of the paint shop is made as nearly fireproof as possible and thoroughly insulated with two courses of 15-lb. asphalt laid between two courses of 30-lb. felt. The partitions are fireproof and provided with sliding fire doors where necessary.

Adequate Provision for Lighting and Heating

By means of the alternate high- and low-roof construction afforded in the main paint-shop building a substantial amount of north light is available to supplement that of the large steel sash windows and excellent light is provided within the shop during daylight hours. For night painting operations adequate illumination is furnished by means of eighty-four 200-watt overhead lights, mounted in vapor-proof fixtures just below the roof trusses.

Particular attention is also paid to maintaining a temperature of not less than 65 deg. F. in the paint shop at all times. This is made possible by the well-insulated roof construction in conjunction with the provision of ample direct radiation around the doors and side walls, supplemented by eight overhead heating units located in the center aisle and used only in the severe cold weather. These heating units include six in the main shop and two in the varnish room. They are compact electric motor-driven units which take in shop air on one side and blow it through steam-heating coils and back into the shop in three directions, as shown in one of the illustrations. A 15-hp. motor-driven fan with a maximum capacity of 80,000 cu. ft. per min. furnishes warm air to the spray room to replace that removed through the exhaust stacks. This air is drawn from the upper part of the main paint shop and delivered through large rectangular galvanized-iron ducts to suitable openings in the east wall of the spray room at about an 8-ft. level.

Originally, two canopy-type exhaust hoods, each 91 ft. long, were installed over Tracks 1 and 2 in the spray room. The results with these were so satisfactory they have been supplemented by the installation of two more units of the same size over Tracks 3 and 4, so that four canopies are now available for the spray painting of cars. Each of these canopies is equipped with five 5-hp. 42-in. fan-type exhausters which may be operated individually or altogether, as needed. In addition a 7½-hp. blower fan supplies air to floor ducts and suitable slots in the floor which direct a narrow curtain of air upward past each side of the car, conveying all fumes into the



Luggage racks suspended for drying on small swing cranes on the varnish-room wall.—The galvanized iron ducts conduct warm shop air under pressure to the spray room

overhead canopy. Distributing plates in the floor ducts assure delivery of the air at a uniform pressure throughout the length of the slots and the air velocity may be varied from 200 to 500 ft. per min., dependent upon the requirements. In order to conserve warm air in the spray room during cold weather, the exhaust stacks are provided with automatic dampers, each of which opens only when that particular stack is in operation.

Ample illumination is provided by means of thirty 300-watt lights per canopy, these lights being mounted in vapor-proof reflectors at 6-ft. intervals along the lower edges of the canopies. This intensive light, thrown directly on the car sides where it is needed, is supplemented by 200-watt overhead lights in the spray room.

When passenger cars are sent to the Beech Grove shop for overhauling they are stripped and moved to the sandblast shed where a thorough cleaning job is done, which includes the removal of all old paint, dirt, rust and scale. Just as soon as the sandblast operation is completed a priming coat is applied by the spray method. In fact, all car parts are sprayed, except the roofs. Each car then moves to the coach shop for necessary repairs, all new work and welded joints being cleaned and touched up with the primer in the coach

shop. The car is then moved outside of the coach shop, thoroughly blown out and the underneath parts sprayed. Sheet-metal shields, made to window size from second-hand car-roofing material, with 39-in. holes cut in the centers for ventilation purposes when painting the car interiors, are applied in place of the sash. After being moved into the paint shop the car exteriors are puttied and glazed where necessary and a coat of surfacer applied. Exterior surfaces are sandpapered and the two coats of the railroad company's standard finish applied. When quick-drying finishes are applied it takes a painter about 1¼ hrs. to spray each outside coat and these coats are applied one after the other with only 15 min. drying time between.

Dolly for Exterior Spraying

An unusually convenient, flexible and self-propelled painting dolly, shown in one of the illustrations, contributes to a saving of time in spraying operations. This dolly consists of a welded-steel frame constructed primarily of 2-in. and 1½-in. angles and mounted on four 6-in. steel-disc wheels with hard-rubber tires. The main dolly frame is 8½ ft. long by 2 ft. 9 in. wide at the base and has a working platform 7½ ft. long by 17 in. wide and 4 ft. 8 in. high. A supplementary hinged platform, made of steel angles and heavy wire netting, as illustrated, may be swung and locked in a horizontal position 18 in. above the main platform to give additional height when needed. The hand rail, made of ¾-in. pipe, is designed to provide a horizontal section 2 ft. 9 in. high above each platform and convenient side handholds assist in climbing onto the dolly from either end.

Referring to the illustration, it will be noted that one pair of dolly wheels is mounted on automotive type axles arranged to be swivelled and steered by means of a small rod which extends vertically upward to the upper handrail level where it is bent and bracketed to form a steering handle. At this same point on the upper handrail there is provided a brake handwheel and small pulley, connected by a belt to another pulley of the same size

Exterior exhaust pipes and weather caps which are mounted on the roof of the spray room

The Beech Grove paint shop showing a railway mail car on the car hoist

A car under one of the canopy-type exhaust hoods

riveted to the inside face of one of the fixed-axle disc wheels. By this construction the painter can readily steer and move his dolly a few feet at a time alongside the car as the painting progresses, without leaving the working platform.

The car interiors are finished the same as the exteriors up to and including the sanding. Two coats of finish are applied inside, one day being allowed between coats for drying. Each coat takes two painters about three to four hours to apply. No masking is necessary on the interior, because the spray is used down to the side-plate molding, from the side-plate molding down to the window sill, and from the sill to the floor. The window-sill and side-plate molding are cut in afterwards with a brush. When this work is done the car moves back into the paint shop for the trimming operations. The car is lettered, finish trimmed and two coats of clear penciling finish applied over the lettering. As an example eight days are required for a complete refinishing job, including sandblasting and priming.

The installation of such modern finishing facilities as are now in use at Beech Grove makes possible a wide application of such quickly applied and rapid-drying finishes as lacquers, enamels and varnishes. The procedure of refinishing a car using these various finishes follows along the same general lines as previously outlined.

In the case of cars requiring general repairs without sandblasting, the cars are brought in, scrubbed, touched up, abrasions repaired and putty applied. The cars are then sanded and the required finish applied.

Work in the Varnish Room

In the varnish room three spray booths are provided, each being equipped with a 3-hp. fan and an 18-in. exhaust pipe. Interior trim is finished in this department, including seat bases, luggage racks, sash, lighting fixtures and all other trim. Dining-car chairs and other furniture is finished here, as well as roadway materials, such as signal stands, switch lamps, etc. A revolving table is used in the spray booth and as many parts as possible laid on the table top and sprayed one at a time. Screws are dumped into a container equipped with wire screw racks so that only the heads are exposed for the spray.

In finishing car-interior fittings luggage racks receive one primer coat and two coats of finish, then being supported for drying on convenient swing cranes, hinged to brackets on the wall of the room. Sash is sprayed with the same finish as that of the car in which it will be placed. Miscellaneous sign work is also done in the varnish room, as well as glass cutting.

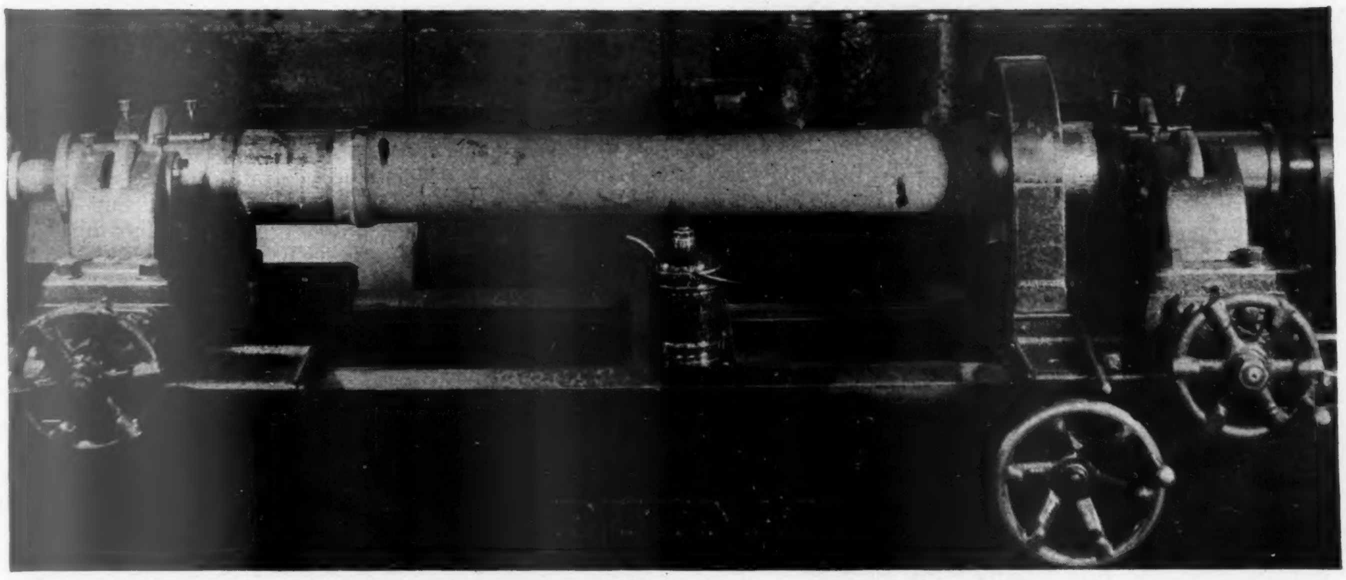
Burnishing Costs Reduced With Alloy Rollers

How tool modernization can increase efficiency and reduce railroad maintenance expenses is illustrated by the alloy burnishing roller for finishing driving axle journals, car axle journals and various locomotive parts. The economy resulting from the use of this roller is effected because of the better and more lasting surface produced and because car journals, crank pins, truck axles or piston rods can be rolled after being sized, thereby eliminating a finish turning operation. Only one or, at most, two rollings are necessary to produce a wearing surface. Smoothness, as shown under a low-power microscope, is attained to an extremely high degree.

A number of railroads have standardized on this type of alloy roller for rolling car-axle and locomotive driving-axle journals, engine-truck axles, crank pins, air-pump rods, piston rods and various other locomotive parts. At many shops, piston rods are rolled in a standard engine lathe with the same type of roller as is used on car axle journals. The roller is held in a tool holder and set up against the rod as tightly as is necessary and the regular feed is applied. A 4-in. piston rod, 48 in. long, rolled in this way, can be completely burnished in 15 min. At a surface speed of 150 ft. per min., and a feed of $3\frac{1}{16}$ in. per min., only one rolling is required. The alloy roller on this job has been in service for over two years.

Similar rollers at other shops have been in service for over five years, some having burnished over 21,000

Close-up of the two opposed rollers rolling the right-hand journal of a car axle on a standard car-axle burnishing machine



A car-axle burnishing machine for producing two finished journals from size-turned surfaces at a rate of one every 7 min.—These rollers have finished over 21,000 journals.

car-axle journals without requiring any maintenance whatsoever. The low overall maintenance expense is due largely to the fact that the roller is made of an alloy of cobalt, chromium and tungsten, known as Haynes Stellite. The metal is quite hard, has a low coefficient of friction, and wears slowly. In addition, it retains a fine finish which is imparted to every piece which it burnishes. The use of the roller makes it just as easy to change a lathe over for burnishing as it is to change a cutting tool.

A standard car-axle burnishing machine in service in another Eastern railroad shop makes use of four of these alloy rollers. These rollers are double opposed, two burnishing each journal of a car axle at the same time and finishing both journals in an overall time of 7 min. with the axle turning at the rate of 75 r.p.m. and a roller feed of $5\frac{1}{2}$ in. per min., the two journals, each 10 in. long, can be rolled in about 2 min. In this case, in order to insure absolute perfection in the journal surfaces, each journal is rolled twice.

Questions and Answers On the AB Brake

68—*Q.—What size is the opening in timing choke 153 and what duty does it perform?* A.—$\frac{9}{64}$ in. It controls the third stage of brake cylinder pressure build-up during an emergency application.

69—*Q.—What size brake cylinder is standard with this equipment?* A.—10-in. by 12-in.

70—*Q.—With what type piston is this cylinder equipped?* A.—It is equipped with a hollow sleeve which provides for a loose push rod that is attached to the lever and rods of the brake rigging.

71—*Q.—With what kind of pressure head is the cylinder equipped?* A.—It is equipped with two kinds: one having lever brackets; one a plain head.

72—*Q.—Where is the brake-cylinder pipe connection?* A.—On the former the connection is located at the side of the lever bracket, and on the latter directly in the center of the head.

73—*Q.—What type of connections are used?* A.—Three-quarter reinforced flanged union connection.

74—*Q.—Is it necessary to open the cylinder in order to lubricate it?* A.—No. Tapped and plugged openings are provided for this purpose.

75—*Q.—Where is the lubricant applied to oil the piston sleeve and rings?* A.—Through a tapped opening in the non-pressure head.

76—*Q.—Where are the openings for lubricating piston and cylinder?* A.—Plugs are located at the pressure end of the cylinder wall, top and bottom.

77—*Q.—How are the ports leading to these openings arranged?* A.—They are so located as to deliver lubricant into a groove in the piston which is formed back of the packing cup and in front of a felt swab.

78—*Q.—What is the advantage gained through the use of a swab?* A.—The swab serves a double purpose. It prevents overflow from the groove to the non-pressure side of the piston when applying lubricant and distributes the lubricant along the cylinder walls with each application and release of the piston.

79—*Q.—What provision has been made to prevent entry of dirt?* A.—The piston rod is ground true and the non-pressure head is fitted with three metallic packing rings, designed to form a seal, and also a felt swab.

80—*Q.—As it is essential for atmospheric pressure to enter the non-pressure end during release movement, what arrangement is provided?* A.—The non-pressure head is fitted with a curled-hair strainer open to the atmosphere.

81—*Q.—Describe this arrangement.* A.—This strainer is of the cartridge type held in place by a breather cover which prevents flying dirt and water from contacting directly with the strainer.

82—*Q.—What type packing cup is used?* A.—A cup formed to fit the piston head and not cut out in the center. The cup is snapped on, over a shoulder which is machined on the piston head, no follower plate and studs or expander ring being required.

Combined Dirt Collector and Cut-Out Cock

83—*Q.—What is this device composed of?* A.—A combination of a dirt collector and cut-out cock, provided with bolting flanges for pipe connections.

84—*Q.—What are the positions of the cut-out cock handle?* A.—Vertical when open—horizontal when closed.

85—*Q.—What type of dirt collector is used?* A.—The standard check valve type, with detachable dirt chamber.

86—*Q.—What is the purpose of the umbrella shaped check valve?* A.—To hold the collected dirt in the dirt chamber under all conditions of air-brake operation.

87—*Q.—What occurs during a heavy reduction, such as during an emergency application.* A.—The check valve seats against a machined seat in the body, shutting off communication between the dirt chamber and the dirt collector outlet.

88—*Q.—What happens, in the event of dust or dirt collecting on top of the check valve?* A.—The valve is so designed and placed on the stem as to permit a rocking motion which shakes off the dust or dirt into the dirt chamber.

89—*Q.—What must be done in order to clean the dirt collector?* A.—It is only necessary to remove two nuts to drop the dirt chamber for cleaning.

Reservoirs

90—*Q.—How is the question of air storage taken care of?* A.—By means of a two-compartment reservoir, one for auxiliary and one for emergency reservoir.

91—*Q.—What is the design of this reservoir?* A.—Two designs are in use, one of welded steel construction, provided with mounting brackets at the top, and with the interior treated with the No-Ox-Id process for rust prevention, while the other reservoir is of cast metal.

92—*Q.—Is the latter made of a single casting?* A.—

(*Continued at top of next column*)

No. It consists of three castings, a separation plate and two flanged chambers.

93—*Q.—Are the flanged chambers identical?* A.—Yes, except that one section has a double lug, and the other compartment has only one lug.

94—*Q.—What care must be taken when assembling the sections?* A.—That the separation plate is so placed that the letters "AUX" on a projecting lug on the plate are facing the auxiliary reservoir chamber, or that the lug marked "EMERG" faces the chamber which is used for the emergency reservoir.

95—*Q.—Which reservoir section has the greater volume?* A.—The emergency reservoir, due to the fact that the separation plate, (which is shaped like a wash bowl) is so placed as to have the convex face project into the auxiliary reservoir chamber.

Spreader for Sawing Thin Boards

To prevent boards or other thin lumber from closing-up after it passes through the rip saw the planing mill foreman on one railroad devised a spreader which is secured to the saw table directly in back of the saw and which follows through the saw grove, spreading the lumber sufficiently to prevent its closing up and binding.

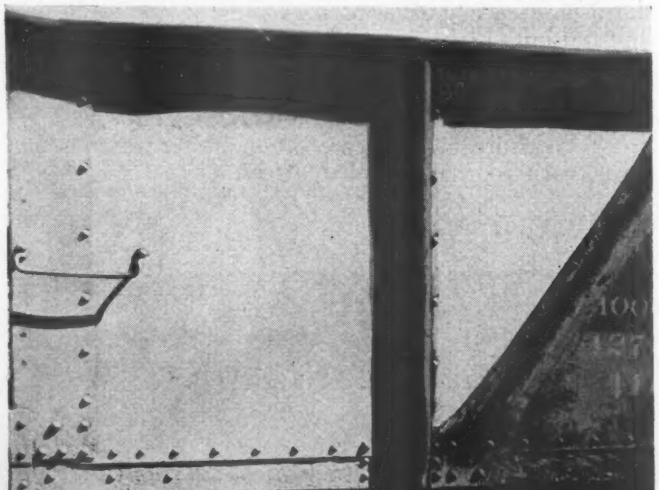
The spreader is made from tool steel and is ground to a knife edge at the front to a thickness of $\frac{1}{16}$-in. larger than the saw thickness. This device will eliminate many accidents in the mill and will permit one man to handle many jobs that ordinarily require two men to handle, especially on thin material.

The spreader follows the saw in the groove

Preservative Coating for Wood, Metal and Other Surfaces

Pure metallic copper of extreme fineness and of the irregular flaky structure known as "dendritic" can now be applied to iron, steel, wood, concrete, or other surfaces which require a protective coating. This new coating is being produced by the American Coppercote, Inc., 480 Lexington Avenue, New York, N. Y., under the name Coppercote.

All types of corrosion problems were taken into account in the development of Coppercote which involved the production of a special vehicle in which the minute flakes of pure metallic copper remain in perfect suspension. While the coating is being applied, a physico-chemical reaction occurs between the particles of copper and its vehicle. Since the copper is dendritic in



Coppercote applied to the panels of a badly rusted gondola car. The heavy scale on two end panels was chipped off and the corrosion burned onto the plates with a blow torch.—This shows the condition of the Coppercote after 15 months exposure.—There is no indication of rust breaking through the surface

structure rather than granular, a closely knit coating results which, when set, forms a tough hard metallic surface. When applied to a surface of ferrous metal it is claimed that corrosion will be prevented completely, and when applied to a surface already rusted, it will arrest any further corrosive action. It is said that the

Coppercote will not crack, scale nor chip as a result of extremes of temperature nor is it affected by the ultra-violet rays of the sun.

A turbulent action which takes place when Coppercote is applied causes it to spread itself automatically and to work its way into every pore of the coated surface to which it becomes thoroughly united. The result is a sealed metallic surface said to be permanently impenetrable by either air or moisture and therefore a positive protection against corrosion. This action throws off every air bubble and closes every pin hole, but more important than this, there occurs a definite stratification of the metallic copper and its vehicle. The copper particles combine and adhere closely to the base while the vehicle rises and forms a second protective film. The phenomenon permits the use of various colors in the vehicle.

Coppercote has been demonstrated to be a non-conductor of electricity. Due to the insulative character of the coating, destructive electrolytic action is impossible.

Many severe tests covering a period of several years have demonstrated that Coppercote is an effective preservative coating suitable for a variety of surfaces and conditions. Coppercote has resisted corrosion on steel columns under conditions of extreme dampness; on deeply corroded specimens of angle iron buried in coal cinders for one year; on steel specimens buried in alkaline soil for two years, and on steel panels immersed in gasoline for extended periods. In another instance a heavy steel test specimen was treated with Coppercote and attached to a pier in Long Island Sound in such a position that at low tide the specimen was exposed to the elements and to the sun while at high tide it was completely submerged. This test was carried on for a number of months and at its conclusion it is reported that the specimen was found to be in perfect condition.

It has been demonstrated that the application of Coppercote to wooden structures provides effective protection against the termite and also against marine borers including the teredo and limnoria. Extensive tests on wooden panels conducted in waters where marine borers are prevalent revealed that the panels after submersion for many months were completely protected.

In addition to its corrosive proofing qualities, Coppercote is fire resistant and its application to wooden structures will reduce fire hazards. Also, concrete floors, brick walls and similar surfaces can be waterproofed by treatment with Coppercote.

Improved Spray Fluid Nozzles And Atomizer Heads

The Paint Spray Equipment Division of the Alexander Milburn Company, 1493 W. Baltimore St., Baltimore, Md., announce major improvements in atomizer heads and fluid nozzles for their paint spray guns. The fluid nozzle is of an improved design and incorporates features which make it a more efficient and economical unit for spraying various materials. It is made of a high grade, wear-resisting steel and has a long tapered seat which is accurately machined and burnished for perfect alignment with the atomizer head. The air passages are closely spaced and provide a large annular air supply to the atomizer head for increasing the effectiveness of the atomized spray. The internal tapered seat is finished to exacting specifications allowing the paint needle point to seat accurately and prevent dripping or spattering. One particular feature is that the nozzle is machined to seat on the base of the thread of the head, keeping paint or other material out of the threads and thereby eliminating clogging.

The bronze atomizer head is of one-piece design and is made with straight air passages, eliminating friction and rendering it easy to clean. Air requirements are provided by large nonfrictional air passages and expansion chambers which increase the velocity and volume for producing atomization at lower pressures.

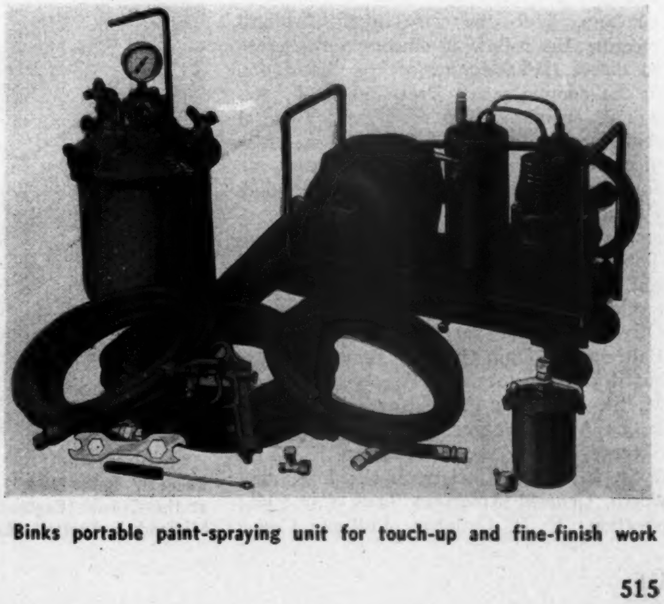
These fluid nozzles and atomizer heads are manufactured for siphon or force feed and in sizes and styles to handle any type of material from the finest lacquer to the heaviest synthetic enamel.

Portable Paint Sprayer

Development of a rubber-tired portable paint-spraying unit has been announced by the Binks Manufacturing Company, 3114 Carroll Avenue, Chicago, Ill. Mounted on a wheeled base, the unit consists of a ½-hp. electric motor, an air-compressor unit, a pressure tank with a capacity of 2 gal., a standard Binks bleeder-type spray gun with adjustable nozzle, and various lengths of rubber hose. A ½-hp. gasoline motor may be used where electricity is not available. Complete, the outfit weighs 180 lb. The spray gun furnished with the unit is a Binks Thor model 6B gun, recommended for touch-up and fine-finish work. An alternate spray gun with a flat nozzle or round and angle sprays can be used for maintenance work.

The compressor is a two-cylinder air-cooled unit, with a bore of 2¼ in. and a stroke of 1¾ in. It has a working pressure of 45 lb. and is driven by a V-belt from the electric motor. The air chamber is equipped with a drain cock and safety valve set at 60 lb. pressure. The chamber also serves as an oil and water extractor.

The pressure tank is equipped with one air-pressure regulator and gage, and a safety valve set for 60 lb. pressure. Three lengths and types of hose are provided, including a 25 ft. length of air hose from the compressor to the tank, a 12 ft. length of ½-in. air hose from the tank to the gun, and a similar length of ⅜-in. hose and connections to go from the tank to the gun.



Binks portable paint-spraying unit for touch-up and fine-finish work

Among the Clubs and Associations

Toronto Railway Club.—W. A. Newman, mechanical engineer of the Canadian Pacific, will discuss The Railway Equipment of the Future at the November 23 meeting of the Toronto Railway Club to be held at 7:45 p.m. at the Royal York Hotel, Toronto.

New York Railroad Club.—The New York Railroad Club will hold its annual dinner on Thursday evening, December 10, at the Commodore Hotel, New York. Herbert W. Wolff, senior vice-president of the American Car & Foundry Company, is general chairman of the General Committee in charge of the affair.

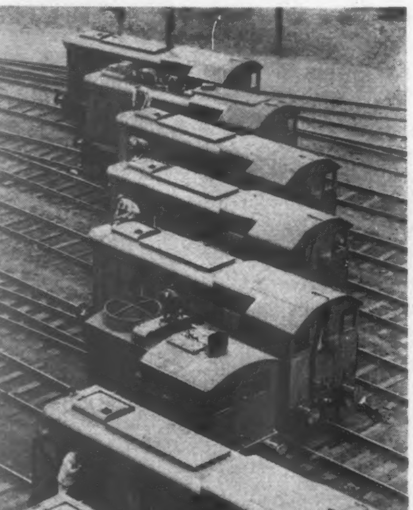
Southern and Southwestern Railway Club.—Electric Welding will be the subject of a paper to be presented by A. M. Candy, consulting engineer of the Hollup Corporation, before the meeting of the Southern and Southwestern Railway Club to be held at 10 a.m. on November 19 at the Ansley Hotel, Atlanta, Ga.

Car Foremen's Association of Chicago.—The annual meeting of the Car Foremen's Association of Chicago, held Friday, October 16, at the LaSalle Hotel, was devoted primarily to an evening of entertainment under the direction of R. M. McKisson, American Steel Foundries, chairman of the social committee, about 500 members and guests of the association being present to enjoy the festivities. At a brief preliminary business meeting presided over by President C. O. Young, Illinois Central, credit for the unusually favorable condition of the association both as regards membership and finance was given to President Young and to the good work of an active booster committee headed by K. A. Milar, Milar & Company, Chicago. ¶ At the close of the business meeting, the following officers were elected to direct the activities of the association in the coming year: President, J. S. Acworth, supervisor of equipment, General American Tank Car Corporation; first vice-president, F. A. Shoulty, general car foreman, Chicago, Milwaukee, St. Paul & Pacific; second vice-president, P. B. Rogers, car shop superintendent, Atchison, Topeka & Santa Fe; treasurer, C. J. Nelson, superintendent, The Chicago Car Interchange Bureau; secretary, George K. Oliver, assistant passenger car foreman, Baltimore & Ohio Chicago Terminal. The board of directors includes W. Snell, C. M. St. P. & P.; F. L. Kartheiser, C. B. & Q.; A. W. Berger, C. & N. W.; J. C. Shreeve, E. J. & E.; C. W. Broo, N. Y. C. & St. L.; G. C. Christy, I. C.; J. S. Acworth, General American Tank Car Corporation; F. R. Callahan, Pullman Company; R. R. Hawk, Wilson Car Lines; A. E. Smith, Union Tank Car Corporation; K. A. Milar, Milar & Company, and W. J. Demmert, Griffin Wheel Company.

A.S.M.E. Annual Meeting

A minimum of simultaneous technical sessions have been arranged for this year's annual meeting of the American Society of Mechanical Engineers to be held at the Engineering Societies building, New York, November 30 to December 4, inclusive. Recourse is being had to two evening sessions, Monday, November 30, and Thursday, December 3, and to an increased number of gatherings, some combined with luncheons, at which the panel method will permit discussion of present trends and topics of interest in general and special fields. Among the discussions planned, to be conducted by the panel method, will be one Wednesday afternoon, December 2, in honor of George Westinghouse, at which former associates will discuss his engineering achievements. The annual dinner will be held on Wednesday evening, December 2.

* * *



Globe photo
Recently built Diesel engines being prepared at the Crewe (England) works of the London, Midland & Scottish Railway for a day's work

The program in part is as follows:

Tuesday, December 1
2 p.m.
Railroads

The Use of Alloy Steels for Side Frame and Bolsters of Freight-Car Trucks, by D. S. Barrows
Report on Railroad Aerodynamics Subcommittee of Aeronautic Division (to be presented by title)
Progress Report of Railroad Mechanical Engineering

4:30 p.m.
Westinghouse Ninetieth Anniversary

8 p.m.
Honors Night
Towne Lecture, by Dr. James Rowland Angell, president of Yale University

Wednesday, December 2
9:30 a.m.
Cutting Metals

Cemented Carbide Tool Maintenance and Application, by L. J. St. Clair

2 p.m.
Machinery and Springs

Discussions of Spring Problems To Include Rubber Springs, Helical Springs and Spring Materials
Bearing Oil-Ring Performance, by R. Baudry and L. M. Tichvinsky
Quieting Machinery, with demonstrations by E. J. Abbott

6:30 p.m.
Annual dinner and Thurston lecture, Astor Hotel

Thursday, December 3
9:30 a.m.

Management
(Jointly with Society for Advancement of Management and Personnel Research Federation)

Dealing with Workers Today
Modern Principles and Practice of Manufacturing Organizations in Employee-Employer Relationship, by W. G. Marshall, T. I. Phillips, J. H. Priest, and R. M. Rumbel—Representatives of the Westinghouse Electric & Manufacturing Company

Corrosion-Resisting Metals—
Symposium I

Introduction to Corrosion Resistant Metals, by F. H. Speller
Aluminum and Its Alloys, by E. H. Dix, Jr., and R. B. Mears.
Construction and Use of Lead Equipment, by G. O. Hiers

2 p.m.
Corrosion-Resisting Metals—
Symposium II

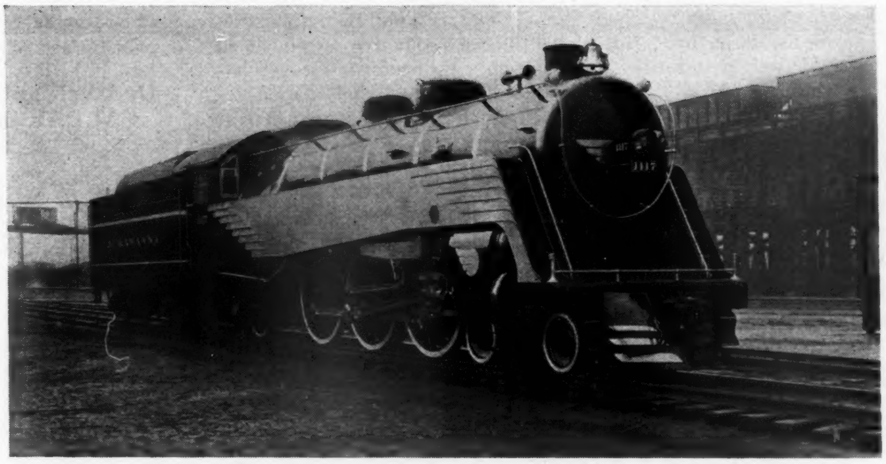
Zinc in the Chemical Industries, by E. A. Anderson
Cast Iron, by Dr. H. L. Maxwell
Copper and Copper-base Alloys, by R. A. Wilkins

Management

Training to be Skilled Workers
Symposium sponsored by Management Division, Committee on Education and Training, Society for Advancement of Management and Personnel Research Federation
F. E. Seale, superintendent, Ford Motor Car Company schools, will discuss the selection of apprentices and their training to operate machines
Chas. G. Simpson, Philadelphia Gas Works, will discuss adult education

8 p.m.
Corrosion-Resisting Metals—
Symposium III

Corrosion-Resistant Steel, by J. H. Crickett
Nickel and Nickel-Base Alloys, by F. L. LaQue



A Delaware, Lackawanna & Western Pacific type passenger locomotive remodeled at that road's Scranton (Pa.) shops to effect a semi-streamline exterior—The finish is in black with chromium striping, trim and skirting below the running boards and silver-leaf lettering and striping on the tender

NEWS

Link Motion Valve Gear—A Correction

THE first equation in the formula appearing with Fig. 2 at the top of page 392 of the September issue of the *Railway Mechanical Engineer* is incorrect. It should be

$$V_h : V_o = V_k : S_o$$

Clinchfield Rail Lubricator—A Correction

ON page 397 of the September issue of the *Railway Mechanical Engineer* the oil-consumption cost per mile of curves per month is given as $.094. This should be $.94.

Power Reverse Gear Agreement Approved by A.A.R.

AN agreement reached between committees representing the carriers and the locomotive brotherhoods governing the installation of power reverse gears on locomotives was approved by member roads of the Association of American Railroads at a special meeting at the Blackstone hotel, Chicago, on September 25. Under the agreement all locomotives built after September 1, 1936, are to be equipped with power reverse gears, while all locomotives used in road service and weighing 150,000 lb. or over on drivers, and all switching locomotives weighing 130,000 lb. or over on drivers, are to be similarly equipped when they are placed in the shops for major repairs; this not later than January 1, 1942, unless the management and representatives of the employees on individual roads agree otherwise.

Negotiations on behalf of the railroads were conducted by Ralph Budd, president of the Chicago, Burlington & Quincy; M. W. Clement, president of the Pennsylvania; L. A. Downs, president of the Illinois Central; J. B. Hill, president of the Louisville & Nashville; F. W. Sargent, president of the Chicago & North Western; F. E. Williamson, president of the New York Central, and J. J. Pelley, president of the association.

The question of installing power reverse gears in locomotives has been under consideration for several years. On January 18, 1933, the Interstate Commerce Commission, after hearings, issued an order directing the railroads to equip their locomotives with power reverse gears before January 1, 1937. The order of the commission was entered on a complaint of the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen, which alleged that manually operated reverse gears are inherently unsafe and unsuitable in principle and design, subjecting the traveling public to unnecessary peril and violating the boiler inspection act. In June, 1933, the American Railway Association and the American Short Line Railroad Association asked the federal district court for the Northern district of Ohio to set aside the commission's order, and on November 24 of that year the order was annulled by three federal judges in court at Cleveland. On January 7, 1935, the Supreme Court of the United States affirmed the decree of the lower court, basing its decision on the ground that the commission could make an order of the kind only in the interests of safety, and that there was an absence of any real finding that safe operation requires the discontinuance of the manual reverse gear and the substitution of the power reverse gear. Upon the request of the Brotherhood of Locomotive Engineers, the commission reopened the case on October 29, 1935, and briefs were filed in July, 1936. Since the commission has not rendered its decision, this agreement is expected to result in the dismissal of the proceedings.

Missouri Pacific Rebuilding Enginehouse

THE Missouri Pacific has awarded a contract for rebuilding its enginehouse at Osawatomie, Kan., which was recently largely destroyed by fire, to the S. Patti Construction Company, Kansas City, Mo. As in the case of the old structure, the new enginehouse will consist of eighteen 110 ft. and 120 ft. stalls.

R. F. & P. Plans Additions to Acca Terminal

THE Richmond, Fredericksburg & Potomac has authorized additions to its Acca locomotive terminal at Richmond, Va. The plans call for a machine and repair shop and new storehouse building with the necessary tracks; removal and reconstruction of the boiler shop and the removal and relocation of machine tools, etc. The work, being carried out by company forces, will cost about $135,000.

Heavy Train Demonstration on Union Railroad

PRESIDENT R. T. Rossell of the Union Railroad Company, together with President George H. Houston and Vice-President Robert S. Binkerd of the Baldwin Locomotive Works, were hosts to a large party of railroad executives assembled in Pittsburgh, Friday, October 9, to witness a demonstration of the powerful switching and transfer locomotives which were built by the Baldwin Locomotive Works for the Union Railroad and which have been in service since last spring. The locomotives, with an 8,000-ton train, were operated over a ruling grade of 1.39, which is more than two and a half miles long.

(Turn to next left-hand page)

These locomotives, which are of the 0-10-2 type, have 61-in. driving wheels, 28-in. by 32-in. cylinders, and a total weight for the engine of 404,360 lb., with 343,930 lb. on the driving wheels. They exert a tractive force of 90,900 lb. and are equipped with reversible boosters, driving on the front tender truck, which develop a tractive force of about 17,000 lb. at starting.

Equipment Improvement Programs

THE Baltimore & Ohio has started work on locomotive repairs in four of its principal shops. The reconditioning and repair of 100 freight locomotives are included in the program. To perform the specialized work of locomotive rehabilitation requires the return of 250 employees at Baltimore, (Mt. Clare), Md., 150 at Cumberland, 150 at Glenwood, Pa., and 175 at DuBois, a total of 725 employees. Work will also start shortly on the rebuilding of 1,000 box cars, in the car shops at Cumberland, Md., Keyser, W. Va., DuBois, Pa., Chillicothe, O., and Washington, Ind. The work will require the re-employment of 550 carmen. When completed, the cars will be of the all-steel type, with the covered-wagon top which the B. & O. developed last year.

New Equipment

Road	No. of locos.	Type of loco.	Builder
	LOCOMOTIVE ORDERS		
Atchison, Topeka & Santa Fe........	1	4-6-4	Baldwin Loco. Wks.
	1	4-8-4	Baldwin Loco. Wks.
Birmingham & Southern............	5	900-hp. Diesel-elec.	Electro-Motive Corp.
Boston & Maine....................	5[1]	4-8-2	Baldwin Loco. Wks.
	5[1]	4-6-2	Lima Loco. Wks.
Detroit & Toledo Shore Line........	3	2-8-2	Lima Loco. Wks.
Kansas City	10	2-10-4	Lima Loco. Wks.
Universal Atlas Cement Co..........	1	600 hp. Diesel-elec. switcher	American Loco. Co.
	LOCOMOTIVE INQUIRIES		
Chicago, Milwaukee, St. Paul & Pacific	30[2]	4-8-4 freight	....
	1	Hiawatha type	....
	7	Boosters	....
Denver & Rio Grande Western......	5	4-8-4	....
	10	4-6-6-4	....
New York Central System...........	25	4-6-4	....
	25[3]	0-8-0	....
Union Pacific	20	4-8-4	....
Western Pacific	4	2-8-8-2	....
	7	4-6-6-4	....
Wheeling & Lake Erie.............	10	2-8-4	....
	FREIGHT CAR ORDERS		
Road	No. of cars	Type of car	Builder
Bethlehem Steel Co................	100	70-ton hopper	Company shops
Chicago & Eastern Illinois..........	500	50-ton box	Gen. American Trans. Corp.
Cincinnati, New Orleans & Texas Pacific	10	Koppel air-dump	Pressed Steel Car Co.
Kansas City Southern..............	500	Box	Pullman-Std. Car Mfg. Co.
	300	Box	Gen. American Trans. Corp.
	100	Gondolas	Mt. Vernon Car Mfg. Co.
Kennecott Copper Corp.............	250	100-ton ore	Pressed Steel Car Co.
Reading Co.	200	Gondolas	Company shops
	200	Auto.-box	Company shops
St. Louis Southwestern.............	50	Steel underframes for flat cars	American Car & Fdry. Co.
Wabash	400[4]	55-ton hopper	Wabash Car & Equip. Co.[5]
	FREIGHT CAR INQUIRIES		
Chicago, Rock Island & Pacific.......	350	Auto-box with Evans loaders	....
Donora Southern	20	70-ton air dump	....
Gulf, Mobile & Northern............	100	Gondola	....
	150	S. S. box	....
	400[6]	50-ton box	....
Texas Co.	4	10,000-gal. tank	....
Western Pacific	100	50-ton ballast	....
	50	50-ton flat	....
	PASSENGER CAR ORDERS		
Road	No. of cars	Type of car	Builder
Kansas City Southern..............	4[7]	Coaches	Pullman Std. Car Mfg. Co.
	1[7]	Comb. dining and chair car	Pullman Std. Car Mfg. Co.
	PASSENGER CAR INQUIRIES		
Chesapeake & Ohio.................	3	Comb. pass & bagg.	....
Chicago, Rock Island & Pacific......	6 trains[8]	....	....
Seaboard Air Line.................	6	Trailer	....

[1] The five mountain type locomotives will each cost about $125,000. While they are primarily intended for use in freight service, they will be so fast that they can be used for speedy passenger service with long trains. They will be 105 ft. long and weigh over 396 tons each. The tenders will have a capacity for 20,000 gallons of water and 21 tons of coal. The 5 locomotives of the Pacific type will be built for speeds as high as 90 m.p.h. They will be used on fast trains such as The Minute Man, The Pine Tree Limited, The Kennebec Limited, The Cannonball and The Gull. These locomotives will cost about $100,000 each. They will have driving wheels 80 in. in diameter and the tenders are to be equipped with an auxiliary or booster engine used as an aid to smooth starting of long and heavy trains. Delivery of the new passenger locomotives is expected in December and the freight locomotives will be delivered the first part of the year and will go into service as fast as they arrive. Both the freight and passnger locomotives will be equipped with an automatic device which records on a tape the speed at which the engine is operated all the time it is moving. They will also be equipped with mechanical stokers.

[2] The freight locomotives, which will have a traction effort of 70,000 lb., will necessitate an expenditure of $650,000 for the replacement of turntables, the enlargement of enginehouse stalls and the strengthening of bridges in the territory where they are to operate. The passenger locomotive will be the same type as the three now in service on the Hiawatha.

[3] For service on the Pittsburgh & Lake Erie.

[4] Authorized by the federal district court.

[5] A subsidiary of the Wabash.

[6] Alternate bid.

[7] To be air conditioned.

[8] The Rock Island, subject to the approval of the federal district court and the Interstate Commerce Commission, will purchase six light-weight streamlined trains at a cost of approximately $2,500,000. Alternative bids have been asked on aluminum and stainless steel and Diesel-electric and steam motive power for three and four car trains.

Denver Zephyr Averages 83.3 M.P.H. on Record Run

A NEW world's record for railway speeds was established by the Chicago, Burlington & Quincy on October 23, when part of the equipment of one of its new Denver Zephyrs—six body units on ten trucks and a two-unit locomotive—covered the 1,017.22 miles from Chicago to Denver in 12 hr. 12 min. 27 sec., an average speed for the entire distance of 83.33 m.p.h. This train, which had come from the builders only a few days before, left the Union station, Chicago, at 7 a.m. (Central Time) and arrived at the Union station in Denver, Colo., at 6:12:27 p.m. (Mountain Time).

On this run, which was made without a stop, a maximum speed of 116 m.p.h. was attained near Brush, Colo., while 26.6 consecutive miles were covered at an average speed of 105.8 m.p.h. in Illinois. The fastest between-station average, 107.30 m.p.h. for 6.11 miles, was made during this stretch. The train traveled from Lincoln, Nebr., to Denver, a distance of 482.66 miles, with a net rise in altitude of 4,035 ft., in 326 min. 32 sec., an average speed for this distance of 88.69 m.p.h.

In addition to the stretch of 26.6 miles at over 100 m.p.h. mentioned above, the Denver Zephyr also operated at speeds above 100 m.p.h. between stations for the distances and speeds shown below:

Miles	Av. m.p.h.
3.14	102.76
15.74	102.75
4.34	104.16
4.69	103.58
6.56	101.36
7.39	100.39
13.73	100.48
11.17	104.18

Since this run bettered the records established by the original Zephyr—a three-unit articulated train—on May 26, 1934, when it ran from Denver to Chicago in 13 hr. 5 min. (at an average speed of 77.5 m.p.h.), comparisons between the two runs are interesting. Since the route of the original Zephyr was into the Century of Progress exhibition grounds in Chicago, instead of into the Union station there, its mileage was 1,015 miles, or two miles less than the record run on October 23. The following table gives a comparative log of the two record runs:

	Distance	Time		
	Miles	Min.	Sec.	Av. m.p.h.
ORIGINAL ZEPHYR				
Halsted St.-Aurora ...	35.8	28	18	75.8
Aurora-Galesburg	124.4	86	0	86.7
Galesburg-Ottumwa ...	117.4	92	25	76.3
Ottumwa-Creston	113.3	91	23	74.4
Creston-Pacific Jct. ..	82.1	60	52	80.9
Pacific Jct.-Lincoln ...	59.6	58	22	61.2
Lincoln-Hastings	96.3	74	47	77.2
Hastings-McCook	132.0	97	41	81.1
McCook-Akron	142.9	97	45	87.7
Akron-Denver	111.4	97	25	68.6
DENVER ZEPHYR				
Halsted St.-Aurora ..	35.8	30	5	71.4
Aurora-Galesburg	124.4	81	25	91.6
Galesburg-Ottumwa ...	117.4	85	25	82.4
Ottumwa-Creston	113.3	88	32	76.7
Creston-Pacific Jct. ...	82.1	56	48	86.7
Pacific Jct.-Lincoln	59.6	59	5	60.5
Lincoln-Hastings	96.3	71	5	81.3
Hastings-McCook	132.0	97	31	81.2
McCook-Akron	142.9	94	9	91.1
Akron-Denver	111.4	74	47	89.3

As on the original run, the Denver Zephyr operated over the freight cut-off from Pacific Junction, Iowa, to Lincoln, Nebr., thus avoiding the Omaha terminals.

Supply Trade Notes

THE NATIONAL CARBIDE SALES CORPORATION, New York, subsidiary of the Air Reduction Company, has changed its name to the National Carbide Corporation.

THE LINDE AIR PRODUCTS COMPANY, New York, a unit of the Union Carbide & Carbon Corporation, has opened a new district office at 2 Virginia street, Charleston, W. Va., with A. R. O'Neal as district manager.

THE GOULD COUPLER CORPORATION, Depew, N. Y., has succeeded to and acquired the entire business of The Gould Coupler Company. No change is contemplated in policies, management or business operations.

W. C. STRAUB, manager of the New York Branch office of the Chicago Pneumatic Tool Company, New York, has been appointed assistant to the executive vice-president, and has been succeeded by A. D. Stem.

THE HAMMOND MACHINERY BUILDERS, INC., Kalamazoo, Mich., has established a new eastern branch office and sales room at 148 East Twenty-third street, New York. The office is in charge of W. J. Holtmeier, eastern manager.

W. L. KEADY, vice-president in charge of operations of the United States Gypsum Company, has been appointed vice-president in charge of sales, and L. H. Atkinson, assistant to the vice-president, has been appointed general sales manager.

B. C. TUCKER, who has been appointed sales representative of the Union Railway Equipment Company at Cleveland, as reported in the August issue of the *Railway Mechanical Engineer*, page 372, also continues as president of the Midland Railway Supply Company.

GEORGE H. BUCHER, vice-president of the Westinghouse Electric & Manufacturing Company, has been elected executive vice-president of the company. Mr. Bucher, who is also president and general manager of the Westinghouse Electric International Company, will have his headquarters at Pittsburgh, Pa.

LESTER A. CRONE, vice-president of the Buffalo Brake Beam Company, has been elected president, with headquarters at New York and Buffalo, N. Y., to succeed Seth A. Crone, deceased. Alfred F. Crone, assistant to president, has been elected vice-president, with headquarters at Buffalo.

THE DEARBORN CHEMICAL COMPANY is completing an extension to its main manufacturing plant, located in the Central Manufacturing District, Chicago, which will result in a 16 per cent increase in floor space. This, the third major addition in 12 years, will be used for a modern machine shop and new equipment for increased business. At the same time the laboratories have been remodeled and new equipment installed. Factory offices have been remodeled and air conditioned.

FRANK H. PRESCOTT, general manager of Delco Products Corporation, division of General Motors Corporation, with headquarters at Dayton, Ohio, has been elected vice-president and general manager of the Electro-Motive Corporation, La Grange, Ill. This will permit H. L. Hamilton, president and general manager, to devote more time to general administration.

THOR M. OLSON has been appointed sales manager of the Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., succeeding Wm. F. Wise. Mr. Olson was general manager of the Continental Tool Works from the time it was founded until shortly before it was acquired by Ex-Cell-O in 1930, during the latter part of this period being president of the company. After becoming associated with the Ex-Cell-O Corporation, Mr. Olson became vice-president and a director, in which capacity he took an active part in sales work.

WILLIAM E. CROCOMBE, president of the American Forge Division of the American Brake Shoe & Foundry Company, and president of the American Manganese Steel Company, has been elected also vice-president of the American Brake Shoe &

William E. Crocombe

Foundry Company with headquarters in Chicago. Mr. Crocombe started in the steel business as an office boy under Don H. Bacon of the Minnesota Iron Company, the Minnesota Steamship Company and the Duluth & Iron Range Railroad Company. When these companies were consolidated with the United States Steel Corporation, Mr. Crocombe entered the employ of the Illinois Steel Company in the rail mill and open hearth departments at the South Works. In 1907 he entered the employ of the Lackawanna Steel Company at Buffalo, N. Y., and from 1909 to 1915 was employed by the Union Drop Forge Company at Chicago. In the latter year he organized the forge department of the Ajax Forge Company, now the American Forge Division of the American Brake Shoe & Foundry Company. In 1924 he was elected president of the American Forge Company, now the American Forge Division of the American Brake Shoe & Foundry Company, and in 1933 was elected president of the American Manganese Steel Company.

R. B. MCCOLL, who has been elected president, member of executive committee, and director of Alco Products, Inc., was born in 1882 at Kilmarnock, Scotland, where he attended the Kilmarnock Academy and the Science and Art College.

R. B. McColl

After serving a special apprenticeship and working in various departments on the Glasgow & Southwestern, he was employed by Robert Stephenson & Sons, locomotive builders, Darlington, England, as a draftsman. In 1905 he went to the Montreal Locomotive Works, Ltd., Montreal, Canada, and served in several departments until he became assistant superintendent, then superintendent of works and finally works manager. In 1917 he was appointed manager of the Munitions Department of the Eddystone Munition Company, where he served until after the Armistice. Returning to England he was appointed general manager of the Armstrong Witworth Company's locomotive department, in charge of the building and equipping of the locomotive works and of the sales, engineering and manufacturing of locomotives. Later, in addition, he was made general manager of the pneumatic tool department, gas and oil engine department, and director of the Works Board of all the company's plants, which included shipbuilding and the construction of Diesel-oil engines for marine work, etc. Mr. McColl is still a member of the Institute of Mechanical Engineers, London, England. In January, 1922, he became attached to the New York office of the American Locomotive Company; the following June he was appointed assistant manager of the Schenectady plant, and in January, 1925, became manager of the plant. In 1931, he was elected president and director of the McIntosh & Seymour

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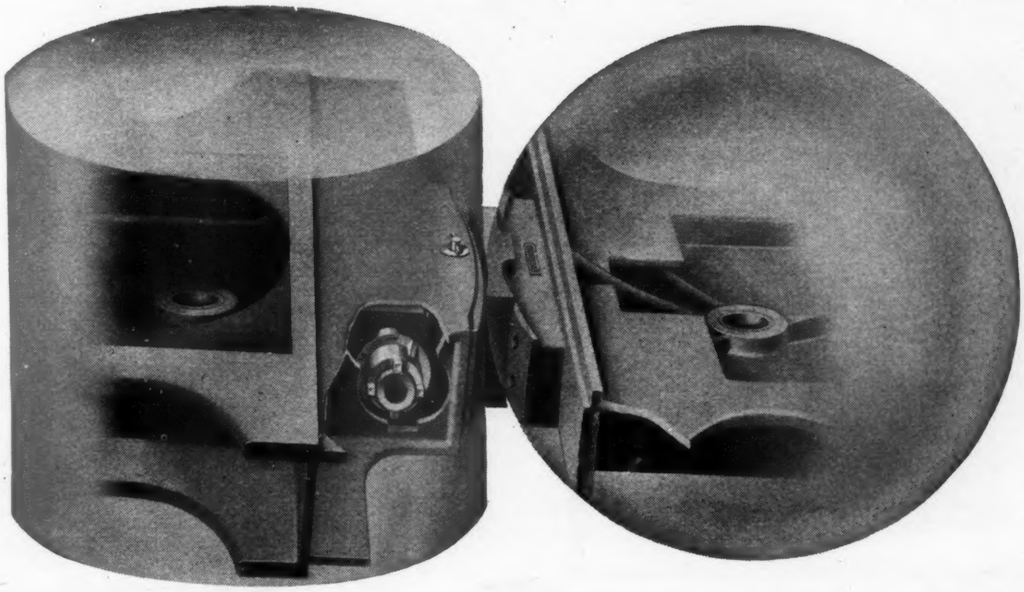
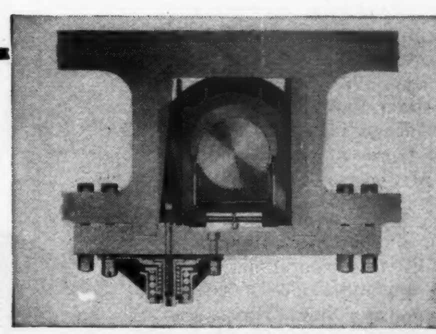
FOR SAFER, EASIER RIDING AND LOWER LOCOMOTIVE MAINTENANCE!



RADIAL BUFFER TYPE E-2



FRANKLIN AUTOMATIC COMPENSATOR AND SNUBBER

The Type E-2 Radial Buffer and Unit Safety Drawbar couple the engine and tender as a unit yet permit unrestricted movement between them.

With the Type E-2 Radial Buffer the radial surfaces are always under pressure contact yet cannot bind. There is no possibility of slack that causes destructive shocks on drawbar and pins. Engine and tender have unrestricted vertical, horizontal and rolling movement but this movement is dampened and engine-tender oscillation eliminated.

The Franklin Type E-2 Radial Buffer increases the safety of engine connections and vastly improves the riding of the locomotive.

Its twin, the Franklin Automatic Compensator and Snubber, maintains accurate driving box adjustment and likewise improves the riding of the locomotive and reduces locomotive and track maintenance costs.

When maintenance is required a replacement part assumes importance equal to that of the device itself and should be purchased with equal care. Use only genuine Franklin repair parts in Franklin equipment.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Corporation, Auburn, N. Y., a division of the American Locomotive Company. Recently, when the McIntosh & Seymour Corporation was merged with the parent company, Mr. McColl was appointed vice-president of the American Locomotive Company, Diesel Engine Division, which position he held at the time of his election as president of Alco Products, Inc.

CHARLES GASTON, a service engineer in the Railroad Department of the Ashton Valve Company at Chicago, has been appointed railroad representative, with headquarters at 21-23 Albany street, New York, succeeding Harry O. Fettinger, deceased.

C. Gaston

Mr. Gaston was born and educated in the vicinity of Louisville, Ky. He was employed as air-brake machinist and foreman and enginehouse foreman on several railroads, his last railroad service having been with the Baltimore & Ohio Chicago Terminal. In February, 1923, he entered the service of the Ashton Valve Company, being located at Chicago until his appointment as railroad representative to succeed Mr. Fettinger. Mr. Gaston is the inventor of the Quadruplex air-brake gage.

JOHN L. DAVIDSON, mechanical engineer of the Valve Pilot Corporation, New York, has been appointed vice-president, with headquarters at New York, the duties assumed with the new office being in addition to those of mechanical engineer. Mr. Davidson was born on July 1, 1894, at Kingston, Ga. After attending the public schools of Quitman, Ga., he entered the Georgia School of Technology, Atlanta, where he received his degree in mechanical engineering in 1915. For about one year after graduation he served as special apprentice in the munitions plant of the Westinghouse Air Brake Co., Wilmerding, Pa., leaving in the spring of 1916 to become a special apprentice in the locomotive shops of the New York Central, at Elkhart, Ind. During the war he secured leave of absence and served in the ordnance department of the United States Army, first as chief army inspector at the Illinois Steel Co., Gary, Ind., and later in an officer's training school at Erie Proving Ground, Ohio. At the close of the war he resumed his training course with the New York Central and after completing it held a number of positions in the test and motive power departments, finally being appointed special engineer in the office of the superintendent of fuel and locomotive performance, from which position he resigned in 1929 to become mechanical engineer of the Valve Pilot Corporation.

H. D. WHITTLESEY, first vice-president and director of sales and distribution, of the Sherwin-Williams Co., Cleveland, Ohio, has been relieved of the duties of director of sales and distribution, and is now devoting his entire time to executive duties and to the further interests of this company's allied connections. A. W. Steudel, who was vice-president, is now vice-president and general manager of the company. K. H. Wood, who has had territorial and division sales experience and for several years has been in charge of railway and marine sales, is now director of sales and distribution of the company.

FRANK P. MCEWEN, formerly southern sales manager of the Oliver Iron & Steel Corp., has been appointed assistant manager of sales of the Upson division of Republic Steel Corp., with headquarters at Cleveland, Ohio. The Upson division is concerned with the manufacture and sale of bolts and nuts. Mr. McEwen was born at Nashville, Tenn., and his first connection was with the Nashville, Chattanooga & St. Louis in the freight department. He left there in 1912 to become commercial agent in charge of solicitation of the Clinchfield Railroad. In April 1917, he enlisted in the Army and was soon commissioned first lieutenant in the 30th Division of the 115th Field Artillery. After spending fourteen months in France, he returned to the Clinchfield Railroad as general western agent. In 1928 he was appointed district sales manager of the Oliver Iron & Steel Corp., and remained with that company until his appointment with the Republic Steel Corp.

Frank P. McEwen

RAYMOND E. ZAHNIZER, who has been in the service of the Jones & Laughlin Steel Corporation since 1912 and for the past 10 years connected with its New York district sales office, has been appointed assistant manager of sales, tin mill products, to succeed William Miller, who was recently appointed manager of sales, sheet and strip mill products. Harold L. Dublin, formerly district sales manager of Follansbee Brothers, at Cleveland, Ohio, who had been with that company for 24 years, has joined the Cleveland office of the Jones & Laughlin Steel Corporation to handle the sale of sheet and strip in that territory.

DAVID DASSO, recently elected vice-president of the American Locomotive Company, Diesel Engine Division, was born in Lima, Peru, in 1891. He attended the School of Engineers, Lima, Peru; one year in the department of engineering, University of Illinois, and in 1912 graduated in mechanical engineering at the Massachusetts Institute of Technology. After a trip through Europe, inspecting machinery manufacturing plants, he returned to Lima, Peru, and took over the management of the Vulcan Iron Works, Peru's most important machine shop and foundry. Shortly after taking over the management of the Vulcan Iron Works, he secured the agencies for various select lines of imports, including automobiles, trucks, and Diesel engines. As a corollary to the automobile equipment he inaugurated the first service station in South America. Later he secured the agency of Sulzer Brothers, Ltd., of Winterthur, Switzerland. Subsequently, Mr. Dasso was engaged in the installation of industrial and governmental projects in South America. In the fall of 1932, he was appointed Sulzer Brothers' representative in New York, which position he held, with the exception of one year, 1935-1936, when he was managing director of Sulzer Brothers' office in Buenos Aires, until his present election as vice-president, American Locomotive Company, Diesel Engine Division.

David Dasso

ARTHUR S. GOBLE has been appointed manager of the Philadelphia district of the Baldwin Locomotive Works, relieving Stewart McNaughton who will devote his full time to his duties as general sales manager. Mr. Goble graduated from the University of Illinois in 1904 and immediately entered the employ of the Chicago & North Western as assistant to the chemist and engineer of tests. In 1911 he left the railroad to enter into sales work for the Baldwin Locomotive Works, first in New York and later in Chicago. Between the years 1918 and 1932 Mr. Goble was district manager of the Baldwin office in

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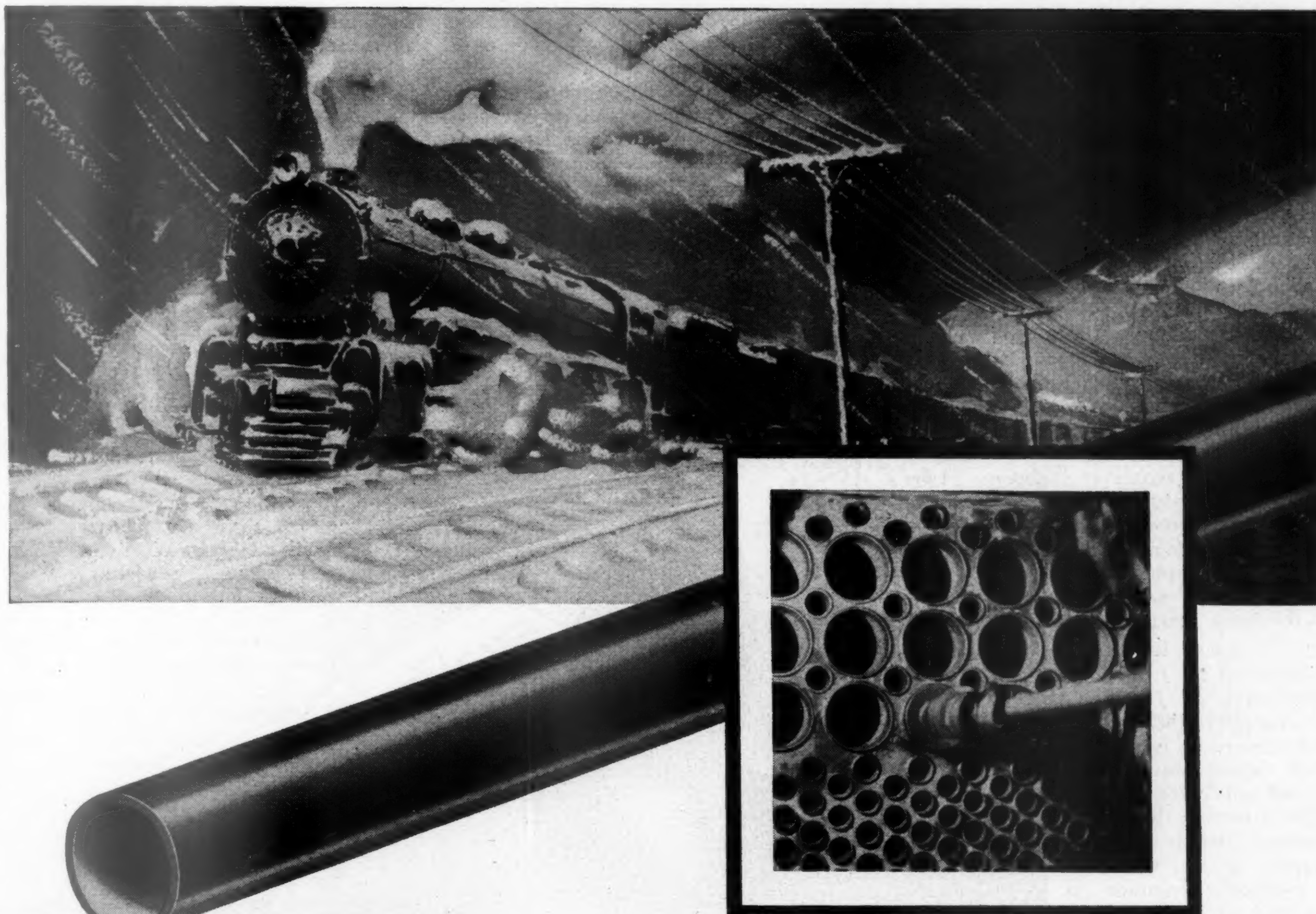

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St. Louis, Mo. For the next two years, he was vice-president of the Hanna Stoker Company, returning to Baldwin on June 1, 1934. From that date until his appointment as manager of the Philadelphia district, he has been engaged in sales work with headquarters in the home office at Philadelphia, Pa.

Lewis W. Metzger, Jr., has been appointed sales representative of The Baldwin Locomotive Works, covering the southern railroads, formerly covered by the late William B. Keys. Mr. Metzger attended school in the East and, in 1913, entered the employ of The Baldwin Locomotive Works as a special apprentice. In May, 1917, he left Baldwin to serve as machine shop foreman with the Bethlehem Steel Company, leaving that position in July, 1919, to return to Baldwin. From March, 1920, until his present appointment, he has been engaged in sales work for both the Baldwin Locomotive Works and the Standard Steel Works Company, in Houston, Texas, Richmond, Va., and in the home office at Philadelphia, Pa.

C. D. Allen has been appointed representative of the J. S. Coffin, Jr., Company, Englewood, N. J. Mr. Allen was born on August 5, 1887, at Mount Holly, Vt., and received his education at the Rochester High School, Mount Hermon Preparatory School and Toronto Technical School. In 1906 he entered the employ of the Central Vermont and in 1910 became locomotive engineer at St. Albans, Vt. He became a locomotive engineer on the Canadian National in June, 1914, and later served as locomotive foreman. In 1920 he became railway sales and service manager of T. McAvity & Sons of Canada, and from April, 1927, until this year was, consecutively, salesman, service engineer and development engineer of Manning, Maxwell & Moore, Inc.

Obituary

J. Victor Bell, who retired, because of ill health in 1930 as southwestern sales manager of the American Steel Foundries, Chicago, died on October 8, in Marshall,

J. Victor Bell

Tex. Mr. Bell was born in that city on June 11, 1868, and entered the service of the Texas & Pacific in 1886, where he was employed in the car department until 1895, at which time he became associated with the American Steel Foundry Company. He continued in the employ of this company, which later formed a part of the American Steel Foundries, until his retirement, with the exception of a short period in 1903 when he was located at Mexico City, D. F., as manager of the Waters-Pierce Oil Company. During his association with the American Steel Foundries he was in charge of the St. Louis office and in 1926 was appointed southwestern sales manager.

Seth A. Crone, president of the Buffalo Brake Beam Co., died at his home in Montclair, N. J., on October 16. Mr. Crone was born on January 6, 1859, at New Market, Ontario. He entered railway service in 1878 with the Quincy, Missouri & Pacific, now the Quincy, Omaha

Seth A. Crone

& Kansas City. From March, 1879, to July, 1882, he was in the car shops of the Missouri Pacific, then to June, 1884, general foreman of the car department of the Texas & St. Louis, now part of the St. Louis Southwestern. He later served as foreman of the Pullman Palace Car Co., until July, 1885, and later, to April, 1886, as assistant superintendent of the Mann Boudoir Car Co. From April, 1886, to October, 1887, he was assistant superintendent of the Chicago and Northwestern district of the Wagner Palace Car Co., and then to March, 1888, was superintendent of the same district for the same company. In March, 1888, he was appointed inspector of equipment on the New York Central & Hudson River and from May, 1891, to June 1, 1899, was superintendent of rolling stock of the same road. In 1900 he was appointed manager of the Spiral Nut Lock Co. In 1902 Mr. Crone organized and became president of the Buffalo Brake Beam Co. During the period 1897 to 1899 Mr. Crone was president of the Master Car Builders Association. At the time of his death he was president and a director of the Buffalo Brake Beam Co., and the Acme Steel & Malleable Iron Works, and a director of Dominion Foundries & Steel, Ltd., Hamilton, Ontario.

Henry Ellsworth Morton, president of the Morton Manufacturing Company, died at his home in Muskegon Heights, Mich., on September 29, at the age of 73. Mr. Morton for 58 years had been active in the development of Morton draw-cut machine tools.

Frank N. Grigg, formerly in the railway supply business, died on September 22, at San Diego, Cal., where he went several years ago because of ill health. Mr. Grigg was born 62 years ago; he served on the Chesapeake & Ohio and later with the Adams & Westlake Company. Before going to California, Mr. Grigg was in the railway supply business in Washington, D. C., and among other companies he represented the Morton Manufacturing Company, the Tuco Products Company, the Heywood-Wakefield Company and the Harlan & Hollingsworth Car Company.

Personal Mention

General

W. R. Elsey, superintendent of floating equipment for the New York Zone of the Pennsylvania and the Long Island at Jersey City, N. J., has been promoted to mechanical engineer of the Pennsylvania, with headquarters at Altoona, Pa. Mr. Elsey was born on April 1, 1892, at Pittsburgh, Pa. He was educated in the public schools of Pittsburgh and Carnegie Institute of Technology. Mr. Elsey entered railroad service on September 26, 1911, with the Pennsylvania and served until 1916 as draftsman at South Pittsburgh, Pa. He then became piecework inspector at Shire Oaks, Pa., and from 1917 to 1920 served as shop inspector at South Pittsburgh. Mr. Elsey served as assistant master mechanic at Canton, Ohio, from 1920 to 1921 and from the latter year until 1923 was motive power inspector at Pittsburgh. From 1923 to 1928 he was assistant master mechanic at Johnstown, Pa., and in the latter year be-

Bachrach

W. R. Elsey

came master mechanic at Baltimore, Md. Mr. Elsey was appointed acting superin-

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tendent floating equipment at New York in 1929 and became superintendent floating equipment in 1930.

H. L. Nancarrow, master mechanic of the Philadelphia Terminal division of the Pennsylvania at Philadelphia, Pa., has been appointed superintendent of the Logansport division, with headquarters at Logansport, Ind. Mr. Nancarrow, who is a graduate of Bucknell university, entered the service of the Pennsylvania on October 7, 1920, as a draftsman in the office of the superintendent of motive power at Philadelphia, Pa. On March 14, 1921, he became a special apprentice at the Altoona (Pa.) machine shops, and on April 17, 1924, inspector of motive power at the same point. On September 1, 1924, he became a gang foreman on the Cleveland and Pittsburgh division and on February 10, 1926, was promoted to assistant enginehouse foreman. Mr. Nancarrow was transferred to the Akron division as assistant master mechanic on March 1, 1927, and on May 16, 1928, was appointed to master mechanic of the Erie and Ashtabula division. On January 1, 1929, he was transferred to the Baltimore division, and thence to the Philadelphia Terminal division.

H. L. Nancarrow

Master Mechanics and Road Foremen

B. W. Johnson, assistant road foreman of engines, Baltimore division, of the Pennsylvania, has been appointed assistant road foreman of engines, New York division.

C. O. Shull, master mechanic of the Chicago Terminal division of the Pennsylvania, has been transferred to the Philadelphia Terminal division, Philadelphia, Pa., to succeed H. L. Nancarrow.

W. R. Davis, assistant master mechanic of the Philadelphia division of the Pennsylvania, with headquarters at Harrisburg, Pa., has been appointed master mechanic of the Chicago Terminal division, succeeding C. O. Shull.

J. D. Davenport, assistant master mechanic of the Chesapeake & Ohio, has been appointed master mechanic of the Hinton division, with headquarters at Hinton, W. Va. The position of assistant master mechanic has been abolished.

R. K. Flanagan, assistant master mechanic of the Chesapeake & Ohio at Huntington, W. Va., has been appointed master mechanic of the Huntington division, with headquarters at Huntington. The position of assistant master mechanic has been abolished.

George Henry Nowell, who has been appointed master mechanic of the Canadian Pacific at Moose Jaw, Sask., as noted in the August issue of the *Railway Mechanical Engineer,* was born on November 13, 1884, at Montreal, Que. He received a public and high-school education and on July 2, 1899, became a machinist apprentice in the employ of the Canadian Pacific. From July 2, 1904, to November 5, 1904, he served as a machinist at Montreal, and then until April 15, 1905, as a machinist at North Bay, Ont. During the next five months he was a machinist on the Grand Trunk at Montreal, returning to the Canadian Pacific on September 1, 1905. On September 30, 1908, he became leading hand at Montreal; on January 15, 1910, charge hand at Montreal; on January 15, 1913, erecting shop foreman at Ogden, Alta.; on March 19, 1914, acting locomotive foreman at Ogden, and on September 4, 1915, locomotive foreman at Cranbrook, B. C. On December 1, 1915, he was appointed division master mechanic, serving at Nelson, B. C., until April 10, 1919; at Revelstoke, B. C., until February 10, 1920; at Lethbridge, Alta., until January 1, 1929; at Regina, Sask., until March 15, 1936, and at Moose Jaw, Sask., until July 1 of this year when he became master mechanic at Moose Jaw.

Car Department

G. P. Kerby has been appointed assistant foreman, air brake shop, of the Canadian National, with headquarters at Transcona, Man., succeeding K. F. Stortts, retired.

Shop and Enginehouse

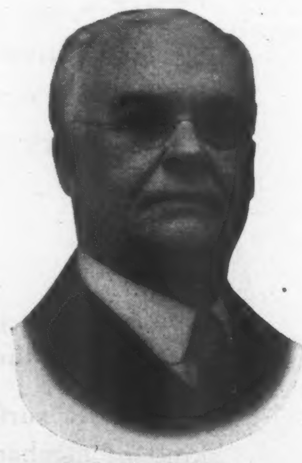
Herbert Watson has been appointed acting locomotive foreman of the Canadian National, with headquarters at Sydney, N. S.

J. M. Clark, shop engineer of the Canadian National at Transcona, Man., has been appointed inspector of tools and machinery, with headquarters at Winnipeg, Man., succeeding W. E. Siler, retired.

Obituary

Arthur L. Graburn, who retired on June 1, 1935, as fuel agent of the Canadian National at Toronto, Ont., died on September 25 at the Ontario Club, Toronto. Mr. Graburn became a clerk in the employ of the Canadian Pacific at Winnipeg, Man., on February 27, 1885; a clerk on the Chicago Great Western at South Park, Minn., on May 1, 1888; a foreman on the Chicago, St. Paul, Minneapolis & Omaha, at St. Paul, Minn., on July 1, 1890; a clerk on the Canadian Pacific at Winnipeg, Man., on October 15, 1890; a wiper on the Canadian Pacific at Winnipeg, on February 15, 1891; news agent on the Canadian Pacific at Winnipeg on September 10, 1891, and an accountant on the Northern Pacific at St. Paul, Minn., on October 5, 1891. He was appointed superintendent of shops of the Great Northern at Great Falls, Mont., on June 1, 1899, and superintendent of shops at St. Cloud, Minn., on June 1, 1900. From September 9, 1906, to November 30, 1907, he was a supplyman at St. Paul. He returned to the Chicago Great Western as an accountant at St. Paul on January 28, 1908, and to the Canadian National on November 16, 1908, as mechanical engineer at Toronto, Ont., He became assistant superintendent of rolling stock of the Canadian National at Toronto on September 23, 1915; general fuel agent at Toronto on January 15, 1919; assistant general fuel agent at Montreal on April 1, 1923, and fuel agent at Toronto on September 1, 1932.

Frederick W. Brazier, retired assistant to the general superintendent of motive power and rolling stock on the New York Central, died on October 4 at his home in Forest Hills, N. Y. Mr. Brazier was born on November 15, 1852, at Boston, Mass., and received his education in grammar school and Comers Business College, Boston. He entered railway service in 1877 as a carpenter on the Fitchburg Railroad (now the Boston & Maine) at Boston, Mass., serving in this capacity and in that of assistant foreman until 1885, when he became general foreman of the car department. From 1893 to 1896, Mr. Brazier was superintendent of the Chicago, New York & Boston Refrigerator Company at Chicago. He served as general foreman of the car deparment of the Illinois Central at Chicago from January to October, 1896, and then became assistant superintendent of machinery of that road. From 1899 to 1904 he served as assistant superintendent rolling stock of the New York Central & Hudson River (now the New York Central) and from 1904 to 1920 was superintendent rolling stock of the New York Central. Mr. Brazier served as assistant to general superintendent motive power and rolling stock of the New York Central from 1920 until his retirement in 1932. He was a past president of the Master Car Builders' Association.



Frederick W. Brazier